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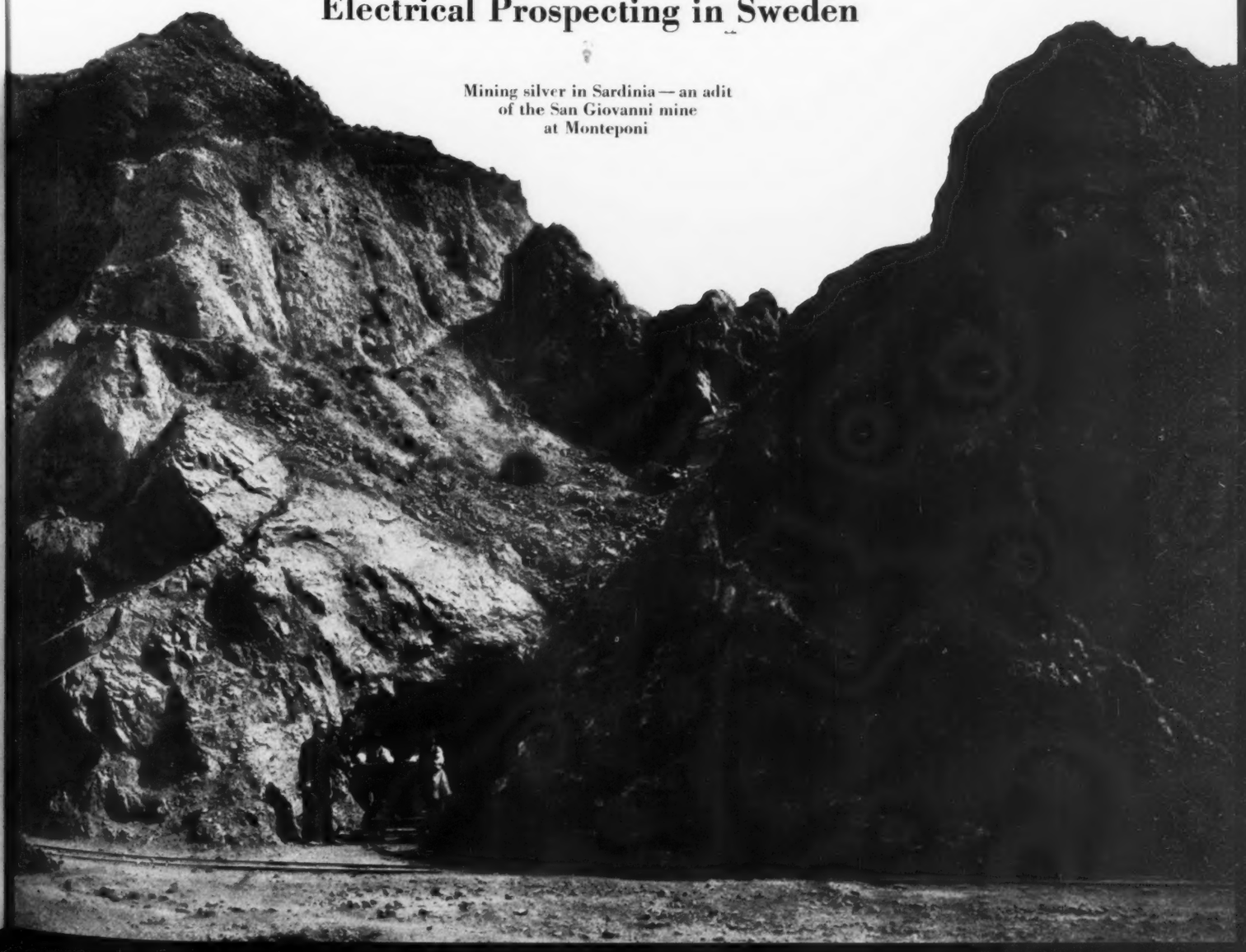

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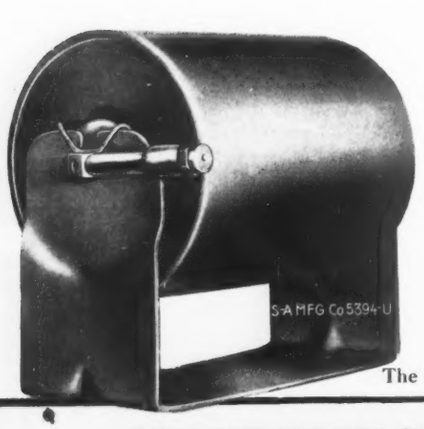

The New Unit

STEPHENS-ADAMSON MFG. CO.

AURORA ILLINOIS

ENGINEERING & MINING
JOURNAL-PRESS
JOSIAH EDWARD SPURR, Editor

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Money and Credit in Europe

THE CARNIVAL of currency and finance in Europe has resulted in some spectacular developments. The fall of the Austrian krone and the German mark resulted in a practical disappearance of all value, and incidentally in an automatic liquidation of all internal debts. While Germany would have had difficulty in passing a bill for a huge capital levy, she accomplished the same result more thoroughly and swiftly by causing her currency to depreciate. Whether or not some such expedient is in the minds of some of the French financiers is a question. France has a huge internal debt, which could be paid off as Germany's has with highly depreciated paper currency of no real value. However, France's record for meeting her obligations is a good one, and nearly every peasant in France is a holder of government bonds: so that the voting power of France would be strongly against such subtle repudiation, just as in this country, where government bonds are not widely held by the average voter, the tendency would be to "soak the rich." Italy, since the bloodless revolution which put the Fascisti in control, has established her lire and her finances; and France can, and probably will, do the same in the end.

In the turmoil many new units of currency have appeared in various countries, bearing new names, some of which are described in a recent issue of the *Commerce Monthly*, published by the National Bank of Commerce, in New York. The new Republic of Latvia has adopted as its coinage unit the lat, equivalent to a gold franc. Also, the Free State of Danzig has adopted a currency unit approximately equivalent to the gold franc—the gulden. Poland has adopted the gold standard, and its unit is the zloty, also with the same value as the gold franc. Lithuania has developed the lit, which is based upon American currency, and has the standard value of a dime.

Austria finally stabilized her currency at around 70,000 kronen to the dollar, and has introduced a new silver coinage, the unit of which is equivalent to 10,000 kronen! Germany has issued the rentenmark, equivalent to the gold mark in value, and backed not by gold but by mortgages on real estate. In effect, it is a finely subdivided mortgage note. The Free City of Bremen has issued special emergency currency in the form of notes in terms of dollars, and which also bear on their face the equivalent value in gold marks.

Russia, having, like Germany, thoroughly destroyed the value of the ruble and abolished all internal indebtedness by this simple expedient, now comes forth cheerfully after the bankruptcy and sets up in business again on the gold standard, the unit being the chervonetz, worth 10 gold rubles or $5.15. And so it goes.

The astounding thing is that some of these outlaw countries, as is the case with Russia, having repudiated all debts, internal and external, come out impudently asking for loans. But it is safe to say that those countries which have gone to the financial wall will have a hard time raising money inside or outside their boundaries in the future, and only on tangible security and at usurious rates of interest.

Out of the ruck of general financial confusion among the nations which underwent the brunt of the World War stands the British Empire and the United States.

Sampling and Appraisal of Mines

ONE of the important committees of the American Institute of Mining and Metallurgical Engineers is the Mining Methods Committee. Its investigations cover the various forms of ore extraction in the different mining industries and extend also to the field of sampling and extraction of ores. Not among the least interesting subjects to mining engineers, it appears, is the last-named subject.

In truth, the apparently simple problem of mine sampling is one that remains not fully understood and is widely interpreted. This is evidenced by the great differences in average value usually obtained by different engineers sampling the same mine. In general, sampling may be divided into two broad groups, at the outset—sampling of mines of low-grade ore through churn drilling (and in this general group may be included the sampling of placers); and, second, all mines which are sampled by cuts. Mines that belong in the second class are far more numerous and the problem of sampling is more complicated, since it has to do with higher grade and often more eccentrically and elusively distributed orebodies. Discussion of sampling of the first named group—the low-grade mines—is in itself worth a treatise: the problems are largely mechanical—that is to say, technical: problems of getting representative samples, and of correct assaying. In the second group, the sampling campaign resolves itself into three parts—where to place the sample cuts, and how to place them; the cutting and quartering and assaying of samples; and the estimation of probably easily accessible tonnage and of future prospects. Only the second of these processes is mechanical; the first and the last must be attacked with special knowledge and judgment—knowledge as to the lie of the orebodies in this mine, and in other mines of the same type. In the mechanical part of the work the job is very often done sloppily—samples are irregularly cut, and assayed without appropriate checks. Specific gravity is guessed at instead of being measured. But even with the most careful mechanical work, the results are of little value unless the sample cuts are properly placed. To do this intelligently, a detailed geological map of the mine should first be made and the sampling program laid out on this. When the samples and assaying are completed, these geological plans and sections will be indispensable in applying the figures obtained to the estimation of tonnage; while for future prognostications, for broad estimates as to chances to come, beyond

the ground actually cut, these geological conceptions are absolutely all that we have to guide us. Whether they are sound or fanciful determines the value of the appraiser's judgment.

Neptunism and Plutonism

IN THE EARLY PART of the last century there was waged a notable controversy as to the origin of basalts, between Werner, a German professor, and Hutton, an Englishman. The former maintained vivaciously that basalts were crystallized out from water solution; the latter, that they were crystallized from a melt, and poured out from the central fires. The two camps thus formed were called the Neptunists and the Plutonists, and the former for a long time held sway, but were finally overcome by the demonstrations of the latter. After this, the question of the origin of granite was disputed in somewhat the same way, it being argued by those that believed in its crystallization from watery solutions that its refractory composition—being siliceous—indicated that it could not have crystallized from fusion. The presence of quartz, whose melting point is very high, was especially pointed to as indicating "water formation." Eventually it was shown by experiment that quartz and other granite minerals form at only a moderately high temperature, in the presence of water and other gases (mineralizers) which act perhaps as catalyzers; so granite was admitted to the "igneous" or "plutonic" rocks.

Residual from this was the argument about pegmatites, whether they were water-formed or fire-formed —igneous or aqueous—"dikes" or "veins"; and this argument lasted until our own generation—being finally practically settled along the same general lines that the granite question was settled: that the pegmatite magmas owed their fluidity to a combination of heat and gases. Thenceforth they, too, were admitted to the igneous group (or "aqueo-igneous") and were called "dikes." But the quartz of granites, so great a stumbling block to their admission to the magmatic rocks, as above seen, and that of pegmatites, which also blocked so long their acknowledgment as belonging to the same group, proved for some time longer too much to stomach when it occurred by itself as an extreme but common phase of pegmatites, having separated from the feldspar; and these quartz pegmatites were until within a few decades commonly classed as "veins," and as deposited from "circulating waters," while the quartz-feldspar pegmatites were classed as "dikes" and as formed by the injection of "magma." When the inevitable press of facts forced the admission that these quartz pegmatites were like the quartz-feldspar pegmatites, a new line was drawn by the water brigade. So long as the quartz dikes (veins or veindikes, if you like) contained no metallic minerals, they might be dikes; but if they were metalliferous they must be "veins," and formed from "circulating waters."

A common form of quartz veindike is that containing gold, and very recently many if not most geologists have been led to the belief that these too are the results of the crystallization of an intruded "magma." Now we see the Neptunists (or the Aquatarians) driven to the last ditch; for there arise those who say that while the gold-quartz "veins" may be intrusive veindikes, yet they will dispute to the last drop of blood the conclusion that any other metals have that origin; and they will take a last stand on the religion of their fathers and believe that these latter have been formed from "circulating waters." The evidence, however, that many other mineral "veins" besides the gold-quartz "veins" in question are intrusive "veindikes," and crystallized out of a "magma," is so plain, that even this last stand promises to be only a passing phase; and with its passing our comprehension of ore deposits will increase immeasurably.

Our instinctive preference for water over magma is partly that we are on closer speaking terms with the former. Moreover, we are influenced broadly by the dictum of the great Lyell that the phenomena of geology have been brought about by processes the equivalent of which are now going on about us—a principle which has proved sound in general, but which has influenced the theory of ore deposition so that it has long been ridiculously wide of the facts.

Mineral Separation According to the Dielectric Constant

WORK to date on the separation of minerals by electrostatic force has been confined to a process that involves the differentiation of charged particles. In this respect, electrostatic and magnetic separation are analogous, but it is impracticable to use an electric field of a strength approaching that of the weakest magnetic field used in practice, because of the unstable dielectric characteristics of a gaseous medium such as air. Sparking would occur under such conditions, thus vitiating the attractive force of the current.

This fact formed the groundwork for research by Dr. H. S. Hatfield, whose new dielectric mineral separation process, described in a recent bulletin of the *Institution of Mining and Metallurgy*, depends on the action of an electrostatic field on uncharged particles. It was apparent that no practicable method existed for the successful separation of minerals by comparatively high-power electrostatic attraction in air, but it was realized that if a medium could be chosen with a dielectric constant greater than that of the solid particle, the attraction would become a repulsion. The problem, therefore, was to find a liquid that was a fairly good insulator, but of adjustable dielectric constant; and success is reported to have resulted by the use of a mixture of kerosene, which has a dielectric constant of about 2, and nitrobenzene, with a dielectric constant of about 36. By varying the proportions, several separations can be effected.

The method has been applied with success on the concentration of Cornish cassiterite and Colorado roscoelite. The current used is 200 volt, 100 cycle, alternating; the electrodes may be in the form of coils, sieves, or needles. The resultant tailing and concentrate are filter-pressed, the excess oil being returned to the circuit. The filter cake is heated in a still to about 300 deg. C., whereby the oil is recovered. As may be imagined, the process is not a cheap one, and the loss of even a small amount of oil involves considerable expense. But operating costs are invariably high during the introductory stages of an innovation of this character. Whatever the success of the process on a commercial scale, Dr. Hatfield is to be congratulated on having contributed something worth while to our conception of the scope of electricity in the separation of minerals. Further developments will be watched with interest.

German Payments and the Copper Market

AN IMPROVED PRICE for copper is dependent greatly upon a settlement of the Franco-German difficulties abroad. This is no new thought, and we have stressed it time and again because the prosperity of the copper industry—our prosperity indirectly—is linked with a disposition of this troublesome question. Six years after the war the problem still awaits solution, largely owing to the fact that the economic realities of the case have not been faced by those who have had most to do with a settlement. Occasionally a brilliant and cold analysis has appeared devoid of all politics and sentimentalism, disclosing the pertinent facts. Such an analysis was Moulton and McGuire's, of the Institute of Economics. The report of the Dawes Committee is awaited by the world in eager expectation that it will disentangle the reparations snarl, but recent news despatches are not reassuring, for they contain rumors of disagreements among committeemen and the injection of much politics in the situation.

It is agreed, of course, that Germany must pay to the utmost, but it is not agreed just how these payments shall be made. The highest authorities concur in the fact that the only manner in which sustained and substantial payments can be made is through a surplus of German exports over imports or through the use of German services such as shipping and insurance. Gradual realization that this is true has caused much consternation among those countries most concerned with a discharge of Germany's external obligations. They do not relish any disturbance to their manufacturing industries. Hence the question has resolved itself into one of how far various nations will permit Germany to go in paying.

America must play an important part in receiving German goods, so prominent, in fact, that Edwin E. Agger, associate professor of economics at Columbia University, has written an article in *The Annalist* entitled "Will America Let Germany Pay?" which discusses this very point. Professor Agger maintains that the United States will have to bear the brunt of the onslaught of German manufactures and that unless we do reparations will fail. He shows that the United States is the only large market open to the Germans today in which they can sell in volume, others being only of secondary interest.

Contrary to one's first impression, Professor Agger believes that the net result will be beneficial to this country. "On the whole, however, it is hardly open to serious question that the United States would gain substantially by the increased German buying power which would result from an excess of German imports into this country. Sellers of bacon and lard, of cotton, of tobacco, of naval stores, and of *copper* would pretty certainly see heavy increase in German purchases. . . . Increased German buying . . . would redound to the benefit of those markets in our country which stand in need of greatest support." (The italics are ours.) In other words, while some manufacturers might lose through the economic adjustment that would be necessary, many raw-material industries, among them copper mining, would profit. This is indeed a comforting thought based upon sound reasoning. It makes us impatient to await a settlement of the trouble in Europe, as it should agricultural industries, which are also seriously in need of improved foreign outlets for their produce.

Use More Copper in Buildings

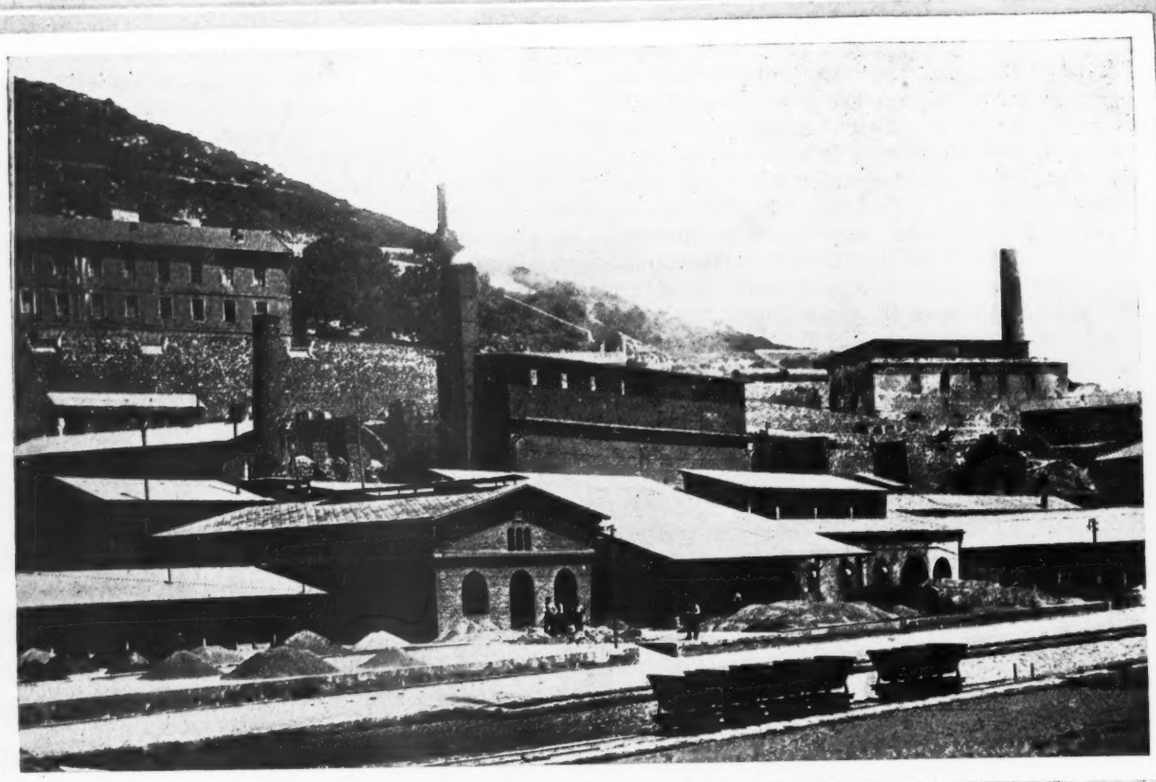
THOUGH THE USE OF COPPER in the building industry is reported to have expanded materially, through the efforts of some of the principal producers and the Copper & Brass Research Association, it does not seem to have become particularly popular as yet on the Pacific Coast. For instance, new buildings being erected in the area devastated by fire at Berkeley, Calif., show no appreciable recognition of the durability and pleasing appearance of the metal. Copper roofs are conspicuous by their absence; opinion is unanimous that their cost is too great for the average citizen's pocketbook. The reason for this disadvantageous condition we do not know, although freighting copper in various forms to and fro across the continent undoubtedly adds to the ultimate cost of the manufactured product. At Oakland, near by, a stamping plant is turning out 1,000 loud-speaker radio horns per day. These are made of sheet brass. The raw copper from Arizona first goes east for refining and manufacture; the sheet brass is then shipped back to California to be fabricated. The bulk of the finished product then goes east for sale and distribution; the whole of the scrap goes east for remelting and fabrication, then back to the Coast again—and so the merry waste goes on, the result being an abnormally high-priced article and the discouragement of the use of copper and brass.

Recognition of the advantages of Californian centers for certain manufacturing industries has been slow, but the advantages are real and they cannot be ignored. The industrial empire to the west is expanding, and its position is being consolidated month by month. There is little chance of a retrograde movement eastward. Therefore, there is logic in the contention that refining of copper and the fabrication of copper and brass in California would stimulate production and result in an enormous increase in utilization.

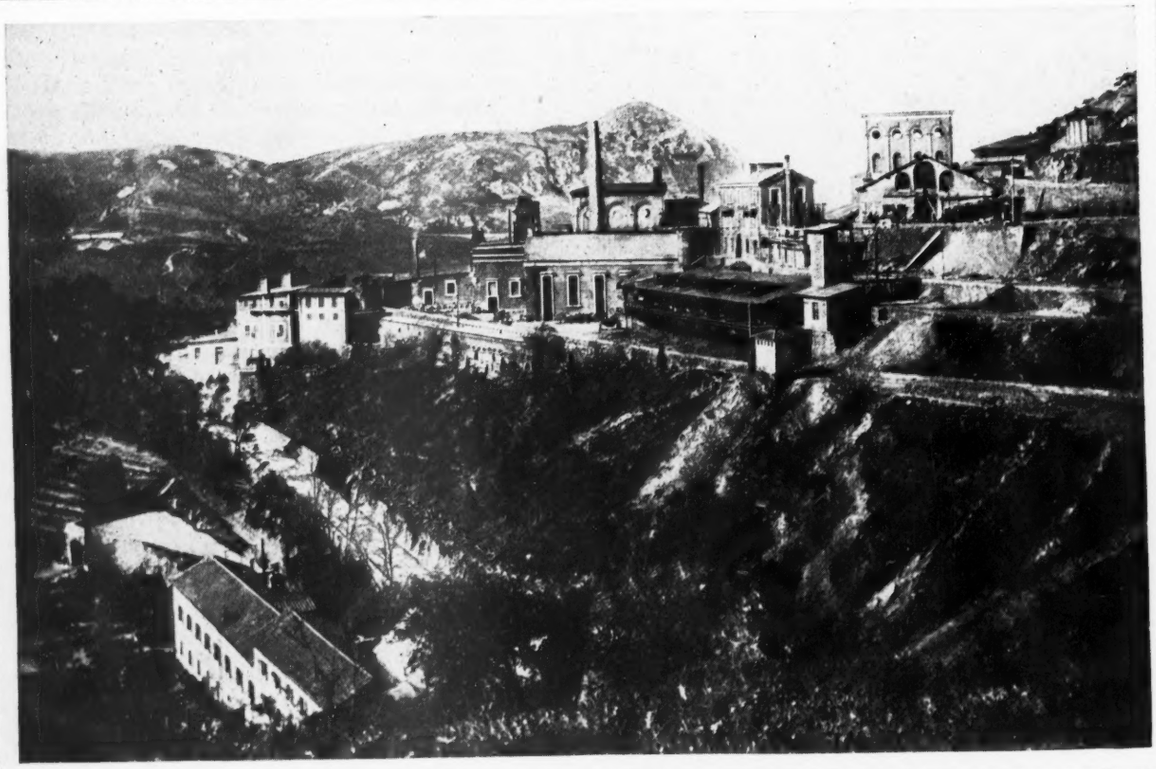
To return to the subject of the use of copper and brass in construction work: Architects favor the use of copper wherever suitable. It is permanent and does not require painting. Its color, especially when oxidized, is artistic. Its use obviates the expense involved in general repair consequent on the substitution of a metallic sheeting that disintegrates. Many constructional problems are simplified by the use of copper. Cornices, for instance, can be made of thin sheeting, requiring little support compared to that needed for other material of equal durability. Copper-covered doors have many advantages.

Unfortunately, however, the notion is current that copper is the rich man's metal, a notion that is encouraged by the cost, over the counter as it were, of copper shingles and copper in other fabricated forms. The sheet-metal worker who is asked to quote on a job requiring copper often names a prohibitive figure for his work, out of all proportion to the cost of the metal, arguing that the builder, because of his interest in copper, has money "to burn."

The Copper & Brass Research Association has continually pointed out to dealers in and handlers of copper and brass that there is much more profit in a large volume of sales at reasonable prices than there is in an occasional sale at an exorbitant profit. Some headway has been made, but it is still true that prices asked the ultimate consumer are, more often than not, unreasonable. When a housebuilder has been "stung," no amount of talk about ultimate economy will mollify him.



Above :- Silver Refinery, San Giovanni Mine
Below :- Mine and Mill, San Giovanni Mine



San Giovanni Mine, An Old Silver Producer

at Monteponi, Sardinia

Marketing of Potash

How an Important Fertilizer Is Bought and Sold

By C. H. MacDowell
President, Armour Fertilizer Works, Chicago, Ill.

C. H. MacDowell

POTASH is a necessity. Neither our chemical industry nor our agriculture can flourish without it. At the present time potash is largely an imported product, Germany and France producing the majority of the world consumption. One American producer, however, is meeting foreign prices and is apparently in successful operation. Approximately 90 per cent of the potash consumed in the United States goes into the manufacture of commercial fertilizer and for direct application to the soil. The other 10 per cent is consumed by the chemical industry. Some of the more important channels of chemical use include the manufacture of black powder, the tanning of leather by the chrome process, the manufacture of matches, the production of certain dyes, the production of fine glass, and in photography. A few years ago all the cyanides used in metallurgical processes were potash salts, but recently the sodium cyanides have supplanted them.

Chief Consumption in Eastern United States

The territory south of the Mason and Dixon Line and the Ohio River and east of the Mississippi River consumes most of our fertilizer production; hence South Atlantic (including Baltimore) and Gulf ports are the principal points of entry for imported material. New York harbor serves as the port of entry for the potash for Middle West agriculture and largely for the North Atlantic States and New England, though a little passes through Boston. Chemical potash enters largely through the North Atlantic ports and is consumed in manufacturing plants along the seaboard from Baltimore north to Boston, or distributed to the chemical manufacturing centers on the Great Lakes.

Previous to 1914 Germany supplied practically all the world's potash. All production was pooled and was distributed by the Kali Syndicate, whose policy was largely dictated by the government. As a result of the war a considerable number of the German mines were secured by the French through the acquisition of Alsace Lorraine. The French immediately entered the American market with their product. In the meantime a great number of American producers had sprung up to meet the demand for potash, as all importation had ceased with the British blockade of German ports. Germany re-entered the field, and German producers, as well as France, cut the price at the seaboard below the delivered cost of American producers. As a result all American plants closed down with the exception of the America Trona Corporation, operating on the brines of Searles Lake, in California. This company is now producing at the rate of about 3,000 tons per month of a high-grade muriate of potash, testing 59½ per cent actual potash (K_2O), which is about 10 per cent higher than the European muriate. This high analysis enables the Trona company to reduce its freight per unit to consumption points, thus permitting it to meet foreign competition. The Bonneville project, in the Great Salt Lake basin, is another potential American supply. New processes will probably allow operators in the Great Salt basin to place on cars potash equal in cost with European port costs, but railroad freight from Utah cannot meet ocean freights from Europe.

Mineral Sold by Only a Few Agents

The marketing of potash in this country is handled from three offices in New York City. Both the French and Germans maintain a selling organization there, and working under these offices each syndicate sells through a broker who handles the direct sales to the fertilizer and chemical trade. The only domestic producer also maintains an office in New York. At present the price is fixed at a so-called "list price," with discounts allowed based on the tonnage purchased. During the last year practically every manufacturer of fertilizer has been able to join some group of buyers whose collective tonnage entitled them to the maximum quantity discount. Since 1909 all the potash mined in Germany has been under the direct supervision of the German Government.

During the year 1922 the following quantities of potash salts were imported into the United States:

	Short Tons
Kainite	169,287
Manure salts	218,406
Muriate	179,484
Sulphate	65,534
Total	632,711

The following potash was imported for use in the chemical industries during the year 1922:

	Short Tons
Bicarbonate	323
Bitartrate (Argol)	11,483
Bitartrate (cream of tartar)	1,042
Carbonate, crude	2,901
Carbonate, crude or black salts	1,839
Carbonate, refined	237
Caustic	6,774
Chlorate	3,855
Chromate and bichromate	4
Cyanide	1,544
Ferricyanide (red prussiate)	38
Ferrocyanide (yellow prussiate)	385
Iodide	0
Nitrate (saltpeter) crude	2,730
Nitrate (saltpeter) refined	401
Permanganate	391
Rochelle salts	251
Total	34,198

In addition to the amount imported, 22,028 short tons of potash was manufactured in the United States, practically all of which was used in the manufacture of fertilizers.

Carnallite, sylvite, hard salt, and other minerals of which potassium chloride is the essential basis occur in abundance in the German deposits, and sylvite and hard salt in the French territory. The capacity of the French and German producers to manufacture potas-

sium chloride for fertilizer and for the further preparation of potassium salts for the chemical and pharmaceutical branches is limited only by the physical ability of their many reducing plants to turn out the product.

For use in the manufacture of fertilizer, potash must be in water-soluble form. The only other specification required by the Department of Agriculture is that the total amount of borax in fertilizer material used must not be more than one-half of 1 per cent. In selling sulphate of potash to the tobacco growers the usual specification is that the chlorine content does not exceed 3 per cent.

The majority of agricultural potash is in the form of potassium chloride in various concentrations, the diluting materials being common salt (sodium chloride) and magnesium chlorides. Chlorides are antagonistic to certain crops, and for these sulphates are used. All fertilizer potash is valued on the basis of K_2O content.

The principal potash salts used in commercial fertilizer mixtures and the basis on which they are sold are as follows:

	Purity in per cent	Sold on Basis in per cent	Form
Muriate of potash	80—85	80 KCl	Potassium chloride
Sulphate of potash	90—95	90 K_2SO_4	Potassium sulphate
Double manure salt	48—53	48K_2SO_4	Potassium sulphate
Manure salt	30	30 K_2O	Double salt of magnesium and potassium chloride
Manure salt	20	20 K_2O	Double salt of magnesium and potassium chloride
Kainite	12.4 K_2O		Mostly potassium chloride

The above salts are in crystallized form, of standard analysis. In the higher grades of muriate and sulphate, material is in the form of very fine crystals barely detectable by the eye. In the lower grades of manure salt and kainite the crystals are larger, the material being ground to pass a 4-mesh screen.

Probably three-quarters of the fertilizer potash is consumed during the months of January to April inclusive, and the remainder is used during the period of August to October inclusive. The demand for potash used in chemicals is distributed fairly evenly throughout the year.

Potash from Germany and France is purchased in minimum quantities of 200 tons bulk salts and 50 tons bagged salts. Practically all of the muriate, sulphate, and double manure salts is bagged, and the kainite and manure salts are imported in bulk form. Potash for chemical purposes is brought in either in bags or in casks, and is usually purchased in whatever quantity the buyer requires. Domestic potash is sold in minimum carload quantities.

Muriate, sulphate, double manure salts, and 30 per cent manure salts are sold at a certain price per ton basis, usual analysis. For instance, muriate of potash is sold on the basis of 80 per cent KCl. If material tests higher than 80 per cent, the buyer pays a proportionate increase in price; if under 80 per cent, a proportionate allowance is made. On the bulk salts, such as 20 per cent manure salts and kainite, the material is sold on a minimum guarantee of so much K_2O, and no extra charge is made for over-run, but a proportionate allowance is made if the shipment is under the guarantee.

In the case of German and French potash salts, the material is sampled as the goods are loaded at the mines, and payment is based on the determination by a German or a French chemist. The Germans sell their potash on the basis of weights taken at time the material is loaded on boat at Hamburg or Bremen. The French have been allowing the buyer to settle on the basis of weights as unloaded at American ports. Domestic manufacturers sell the material on the basis of sampling and weights taken at time it is loaded on board cars.

The following table shows the imports of crude potash salts, in short tons, according to the various grades, from 1913 to 1922 inclusive:

Year	Kainite	Manure Salts	Muriate	Sulphate	Total
1913	521,176	250,529	237,630	44,349	1,053,684
1914	351,866	189,245	185,761	40,224	776,796
1915	7,475	15,403	64,670	12,798	100,255
1916	40	1,241	1,299	1,693	4,273
1917	0	252	683	230	1,165
1918	0	0	424	101	525
1919	57,427	45,372	23,202	1,415	127,416
1920	419,700	356,060	136,194	17,006	928,960
1921	77,365	43,285	79,642	12,458	212,750
1922	167,839	218,405	180,931	64,645	631,820

Potash salts produced in the United States by years from 1915 to 1922, inclusive, in short tons of K_2O, are as follows:

1915	1,000	1919	32,474
1916	9,720	1920	48,077
1917	32,573	1921	10,171
1918	54,803	1922	11,714

The records of the Potash Syndicate in Germany indicate that production of K_2O during the last eight years varied from 356,056 metric tons in 1915 to 614,834 metric tons in 1922. These figures represent minimum and maximum yearly production.

Prices on potash for fertilizers over a period of years, exclusive of the war, have been maintained on a fairly uniform basis. The net cost to the manufacturer over a period of years has not varied, excepting during the war, as much as other raw materials. Kainite testing 12.4 per cent of potash has varied from $5.50 to $9 per ton; 20 per cent manure salts from $7.50 to $12 per ton; muriate from $30 to $36 per ton, basis 80 per cent; sulphate from $40 to $46 per ton, basis 90 per cent. At the present time the Germans have a practical monopoly on the manufacture of sulphate of potash, as little kieserit is found in the Alsatian field. Owing to the high cost of fuel and labor, they have recently increased the price $2.25 per ton. During the war, domestic potash sold at from $4 to $5 a unit K_2O, German muriate as high as $500 a ton and sulphate at $400 a ton. There is no indication on the sellers' part of raising prices still further, and unless the German and French producers reach an agreement, which does not now seem probable, the potash requirements of the fertilizer industry seem assured for the present at a comparatively low price.

Testing Wire Rope Magnetically

An investigation of the possibility of developing a non-destructive test for wire rope in hoisting service has been under way at the Bureau of Standards since July, 1923. At a meeting of the advisory committee for this investigation it was decided that methods involving magnetic testing should be given first consideration. It has been found necessary to obtain certain fundamental information not heretofore available before proceeding with the design of field apparatus.

A method of analysis has been discovered which appears to be capable of indicating the relative proportions of the material which are under tension and under compression. This work has also demonstrated, apparently, that the difficulty heretofore experienced in attempting to find the laws of corelation between magnetic and other physical properties can be attributed to the effect of stress, as the magnetic properties are very sensitive to this influence.

Design and Operation of the United Comstock Mill—II

Removal of Primary Slime, and Sand Leaching, Not Altogether Satisfactory, but Concentrate Treatment and Filter Plant Come Up to Expectations

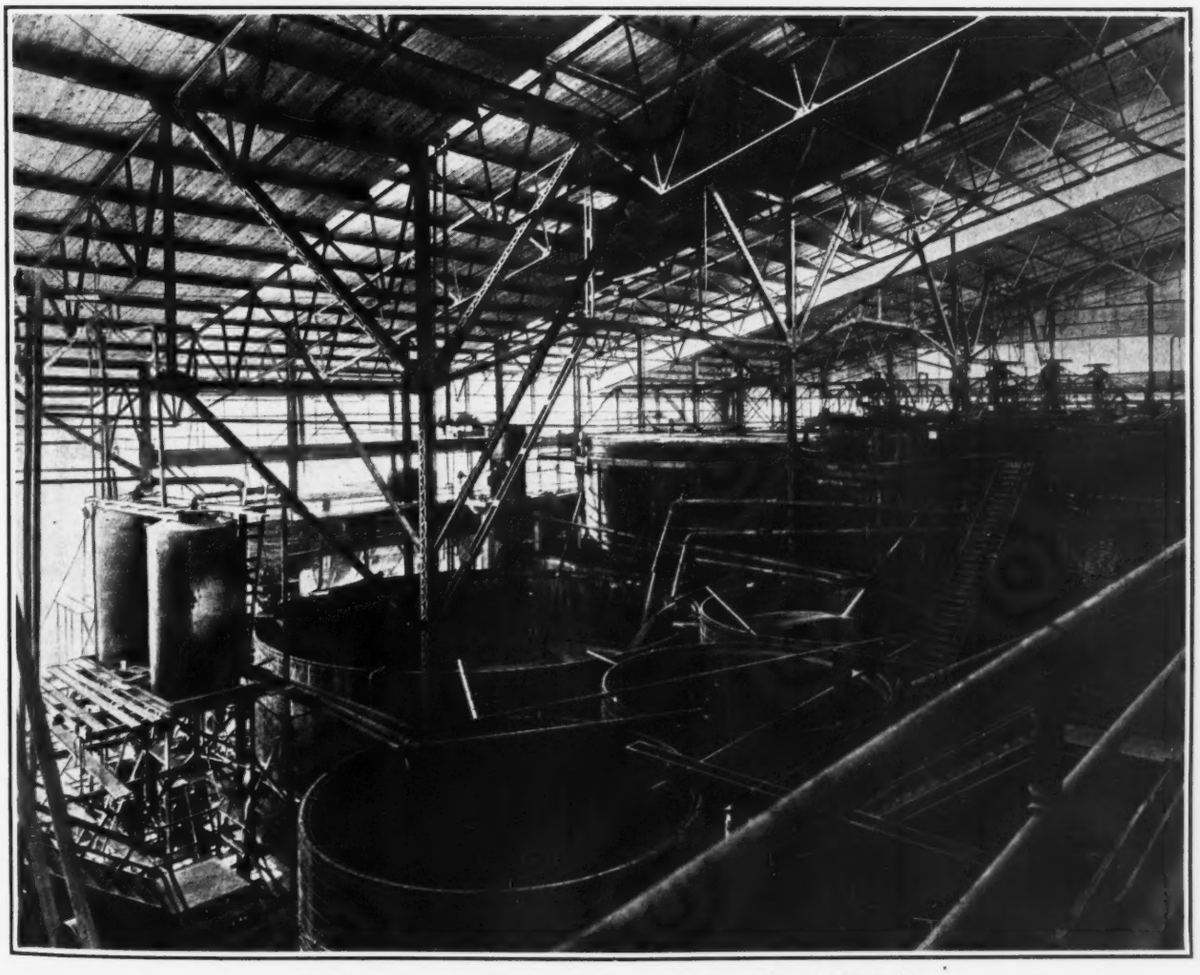
By B. P. Little
Formerly Chief Engineer, United Comstock Mines Co.

CYANIDE TREATMENT at the United Comstock is divided into four parts: primary slime; secondary, or ball-mill, slime; concentrate; and leaching of sand tailing. The principal difficulty occurs in the treatment of primary slime. The silver in this slime is partly insoluble, the assay being appreciably higher than the mill feed from which it was washed, and the mechanical difficulties of handling the slime are great.

Starting with 2,000 tons of feed, the following represents the proportionate division:

	Per Cent	Tons
Soluble salts	0.2	4
Primary slime	10.25	205
Wood pulp	0.25	5
Ball-mill feed	89.45	1,786

The wash water added at the washers will be assumed to be 3,440 tons (a representative figure), of which 3,075 tons will accompany the primary slime at a ratio of 15:1, and 365 tons will amount to 17 per cent moisture in the ball-mill feed. (Of the four tons of ferrous, manganous, and other sulphates presumably dissolved, 12.4 per cent, or nearly ½ ton, accompanies the moisture to the ball mills.) The dilute primary slime pulp flows to the tank house, passing through a screen set near the front wall of the fine-grinding department. This removes the bulk of the wood pulp, which is laundered to the tailrace. The wood pulp assays approximately 0.10 oz. silver per ton, besides containing more or less entangled slime. The screen generally used is 16-mesh woven wire cloth. Although some fine wood works through it, the quantity is not bothersome. From the screen the slime flows to 60x16-ft. Dorr single-tray thickeners, sometimes to one, but more often to two, used either in parallel or alternately. In recent months two have been used constantly, giving a nominal ratio of 53.6 sq.ft. settling area per ton of primary slime.



Solution-storage tanks; Crowe vacuum tanks at the left

The test work indicated that 16.3 sq.ft. settling area would be required, the conditions of test and approximately the conditions of practice being as follows:

	Test	In Practice
Temperature of pulp	70 deg. F.	60 deg. F.
Ratio, water to ore	53:1	15:1
Maximum density of thickened slime	1.24 sp.gr.	1.26 (variable)
Ratio of water to slime at maximum density	2.18	2.0

From the test work we expected to have an excess of capacity with one thickener (3,560 sq.ft. indicated and 5,500 sq.ft. provided), but in practice two such

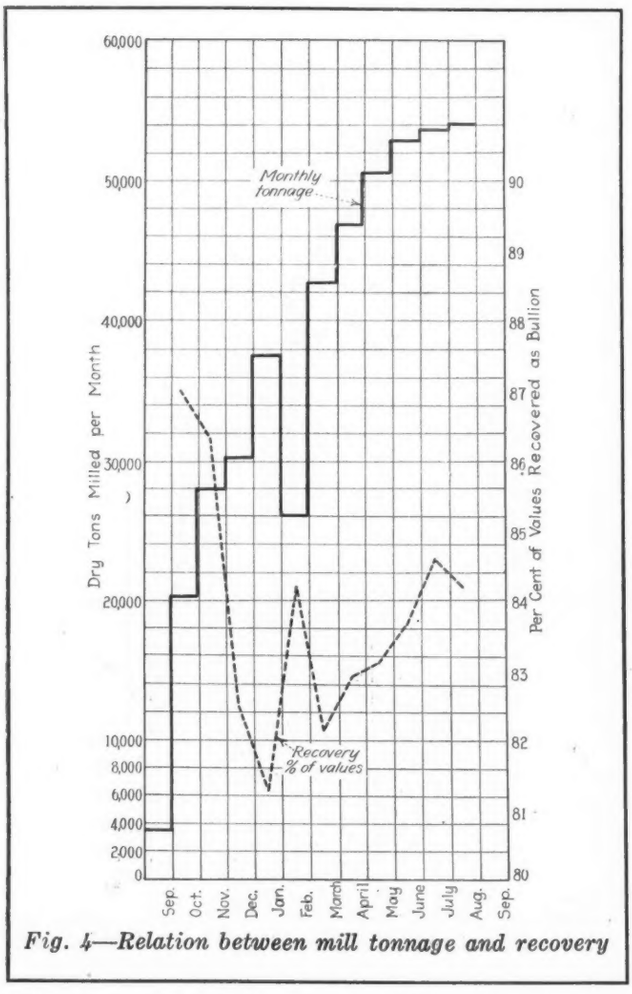


Fig. 4—Relation between mill tonnage and recovery

thickeners are insufficient, and at 70 per cent tonnage capacity and upward there is an overflow of fine slime with the water going to waste, amounting to almost exactly 1 per cent of the mill feed, or twenty tons per day at full capacity. Space does not permit describing the many expedients tried out and discussed to stop this leak nor the speculations and experiments made to determine why the slime should act so differently in practice than in test work.

Up to the end of the initial year of operation, no progress worth mentioning was made to overcome the trouble. Early in the summer the construction of a large outdoor thickener was considered. Plans and estimates were prepared, but no further action was taken, as the effectiveness of an outdoor thickener was open to question, principally because of the high winds prevalent.

The thickened primary slime goes to the Moore filter, and as much as possible of the remaining moisture is removed (about 35 per cent moisture remains in the filter cake). The filter cake is transferred to a vat containing weak barren solution and the remaining moisture is displaced with this. The cake is then blown off into a vat of mill solution, and the resulting pulp pumped to agitator No. 1, where cyanide and lime are added to bring the solution to a content of about 3½ lb. of free sodium cyanide and 1½ lb. of free lime. The pulp is agitated in turn through agitators Nos. 1, 4, 5, and 8. Part of the secondary slime is added to agitator No. 5, and both slimes are combined completely in agitator No. 8. The slimed concentrate tailing from the concentrate treatment plant also goes to agitator No. 1 and receives the same treatment as the primary slime.

Starting with 205 tons of primary slime at the washers, 20 tons overflowed the thickeners, leaving 185 tons delivered to the agitators; to this, 32 tons of concentrate tailing must be added, making 217 tons fed to the primary slime agitation circuit on a 2,000-ton basis. At this rate of feed the primary slime would get twenty-seven hours' treatment (at a pulp ratio of 2.5:1) before reaching agitator No. 8. The highest daily average tonnage for any month has been about 1,800 tons. For short periods it has exceeded 2,000 tons, so that the actual time of treatment varies considerably.

I have already stated that I have never been convinced that this complicated treatment of the primary slime is necessary with ore such as has been received at the mill. The mill costs are not kept in such a way as to show the cost of treating primary slime up to the point where actual cyaniding begins, and the following figures are therefore only estimates, based on observation and such data as were available. The cost of filtering off the water from the primary slime is taken at one-half the cost of operating the filter plant, excepting leaf repairs. Two-thirds of this item is taken as nearly as it can be determined, as the acid slime corrodes the filter leaves much more than does the tailing or secondary slime.

Estimated Cost of Present Treatment of Primary Slime

Primary wash, 2,000 tons at 0.9c.	$18.00
Standardizing 365 tons water to mill solution	
730 lb. sodium cyanide	146.00
547 lb. lime	5.50
Twenty tons slime lost at thickeners at $3.75 recoverable value	75.00
Filtering 185 tons primary slime	50.00
Standardizing solution in filter cake, 130 ib. sodium cyanide	26.00
Cost of preparing slime from 2,000 tons ore	$320.50
Per ton of slime	1.60

Several other mills are cyaniding Comstock ores and one at least tried preliminary water washing and abandoned it. The cyanide consumption in these mills is not much greater than in the United Comstock mill. Two tests recently made on United Comstock ore of current production by an outside mill gave, I am informed, in one case, no greater cyanide consumption, and in the other case less than ¼ lb. greater consumption without the water wash. Assuming ½ lb. more cyanide and 2 lb. more lime would be consumed, the following cost estimate of direct treatment would apply:

Washing 2,000 tons of ore in mill solution at 0.9c.	$81
1,000 lb. sodium cyanide consumed by solubles at 20c.	200
4,000 lb. lime consumed by solubles at 1c.	40
	$258

This represents a direct saving of $62.50 per day, besides releasing thickening and filtering equipment, now used in preliminary work on primary slime, for a more thorough treatment of the slime in cyanide solution, as will be discussed in connection with secondary slime treatment.

In the light of the test work and ore analyses which showed soluble salts capable of reacting with a maximum of 15 lb. of sodium cyanide per ton, it was wise to provide washing equipment, but this does not prove that it has always been profitable to use it. Experienced cyanide millmen will grant that a mill solution after use for some time is a dark and mysterious fluid full of malice and deceit and not always reacting according to laboratory formulas.

Until direct treatment is tried on a working scale the necessity for water washing is open to question, but if proof that it is required is obtained by actual trial, then should not washing be moved ahead of the rolls so as to get the mechanical as well as most of the metallurgical benefit therefrom?

Secondary Slime Treatment

The secondary slime which overflows the bowl classifiers below the ball mills flows to one 60x16-ft. Dorr tray thickener, is thickened to a pulp ratio of 2:1 to 2½:1, and pumped to the agitating circuit. The overflow of this thickener is clear when the alkalinity and temperature are suitable. A normal quantity of secondary slime on a 2,000-ton basis is 860 tons per day. After combining with the primary slime in agitator No. 8, this gives 1,077 tons as the total slime to the tailing filters. Nine agitators, 30 ft. diameter by 24 ft. in depth, are provided with Dorr equipment, and three additional tanks are available, but are not equipped with agitators. The total agitation time is 35½ hours for primary and 22 hours for secondary slime at full tonnage. The three additional agitators would increase this time by 8½ hours. As the tonnage has been less, the time has been correspondingly increased, but the recovery does not seem to bear a direct relation to the treatment time, as in December, 1922, at 50 per cent mill capacity, the slime extraction was 69.6 per cent and in August, 1923, at 90 per cent mill capacity, the slime extraction was 68.2 per cent of contained values.

Fig. 4 shows the total recovery curve platted with respect to monthly tonnage. Little relation between time of treatment and recovery is shown. However, the test work showed generally (but not always) a reasonable gain for 72 hours in treating primary slime and 30 hours for secondary slime. Adding the time in the thickeners, the secondary slime averages about 30 to 32 hours' treatment.

The flow of primary and secondary slime is shown in Fig. 5. Thickeners Nos. 4 and 5 are operated in parallel, one-half the pulp stream to each, and the pregnant solution for precipitation overflows from these thickeners. Here was another debatable point in the design, for our previous layouts had provided for counter-current decantation at this point, but the final flow sheet abandoned this and sent the rich underflow solution (to be still further enriched in agitators No. 7 and 9) direct to the filters, depending on complete replacement of the pregnant solution in the filter cake by water to prevent the loss of dissolved values. In practice perfect replacement is not obtained and the losses have been considerable—enough to justify the necessary changes required to provide counter-current decantation. The additional thickeners would be necessary and some rearrangement of the piping and pumping. If direct cyaniding of the primary slime can be accomplished one thickener will be released and another could be superimposed over a 60-ft. storage tank, giving a two-stage cycle of decantation. Perhaps, on the other hand, if direct cyaniding of primary slime releases part of the filter plant now devoted to it, the enlarged filter capacity available for tailing filtration will provide sufficient time to obtain better replacement of pregnant solution in the filter cake.

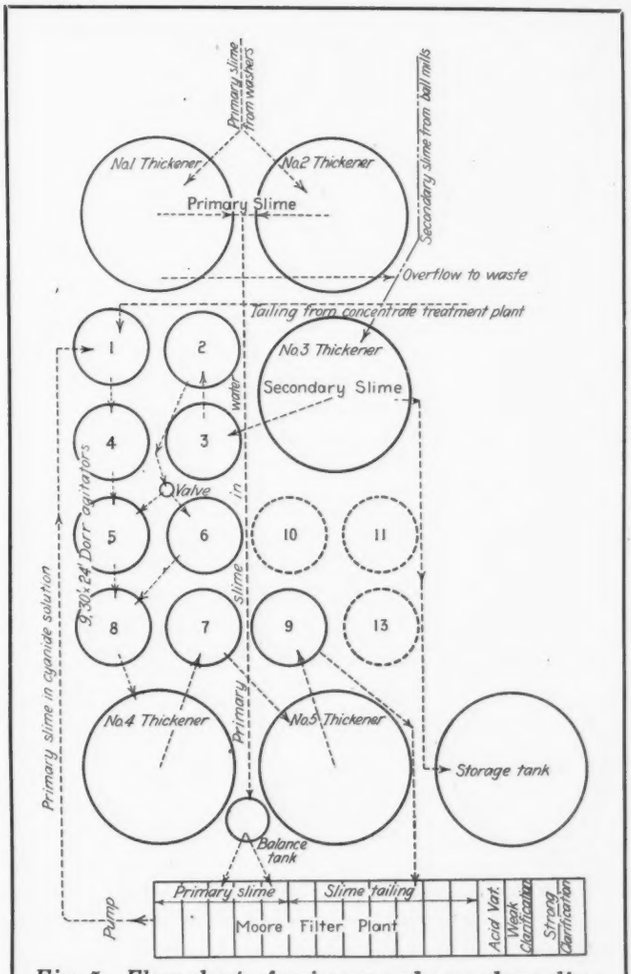
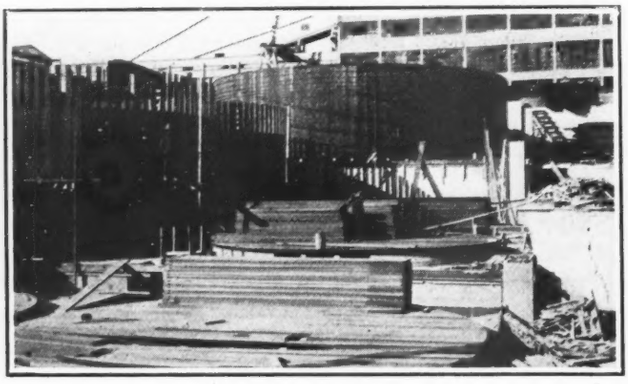


Fig. 5—Flow sheet of primary and secondary slime

Apparently there is about 0.7 oz. silver per ton of slime that is insoluble in the solution used, but there is still a good recoverable margin above that, and pregnant solution in the tailrace is responsible for a part, at least, of the loss.

Method of Treating Concentrate Proves Good

The —300-mesh sulphide pulp overflowing the concentrate Deister tables is laundered to a 35x6-ft. Dorr thickener and thickened to 50 per cent moisture. It is then pumped into concentrate agitator No. 2, thence flows through No. 3 agitator and to concentrate thickener No. 2, where it is diluted and thickened again to 50 per cent moisture, and agitation is completed in concentrate agitators Nos. 4 and 5; it is finally diluted and rethickened in concentrate thickener No. 3 (also 35x6 ft.), and the tailing pumped to join the primary slime at primary slime agitator No. 1. Agitator No. 1 of the concentrate treatment plant has never been equipped with mechanism. The agitators are 15-ft. tanks with 20-ft. staves, equipped with Dorr agitators and at 32 tons of concentrate per day provide for 93 hours' agitation. The extraction has averaged about 95.5 per cent of the gold and 92.5 per cent of the silver.



Erecting the tanks

Probably some additional extraction is made after the tailing leaves the concentrate treatment plant. The overflow solution from thickeners goes to precipitation. The values in the concentrate vary from $30 to $75 per ton, the latter representing recent practice. This part of the plant has operated satisfactorily.

Moore Filters Give Satisfaction

The slime filter plant consists of sixteen vats, each 9x27 ft. and 7½ ft. in vertical depth, below which the bottom slopes to form three inverted pyramidal pockets, with sides sloping 60 deg.; each pocket is 9x9 ft. at the top, the point being about 7 ft. 8 in. below the top of the pockets or 15½ ft. below the top of the vats. The construction is monolithic reinforced concrete, the walls of each pocket converging to and terminating on a concrete column 18x18 in. in section, extending to the ground. The column heights vary from one or two feet at the upper end of the filter bay to twelve to fifteen feet at the lower end. The basement floor conforms to the natural slope of the ground and provides a good grade for the tailrace. The working floor is level with the top of the vats and is of concrete cantilevered out from the vat walls.

Overhead is a structural steel craneway carrying two 40-ton Whiting electric cranes, especially built to transfer the filter baskets, the craneway being 33½ ft. span, center to center of 60-lb. rails. Three vats are used for clarifying pregnant solution; one is lined with sheet lead and used as an acid tank in which the filter leaves are periodically de-limed, leaving twelve vats available for filtering primary and tailing slimes.

Filtering primary slime requires a minimum of one loading vat, one replacement vat, and one "blow-off" vat. In recent practice one or two additional vats are used on primary slime. This leaves at best only nine vats for filtering tailing and only seven if the primary slime is adequately filtered when tonnage is high. The filter leaves are 6x8 ft., 96 sq.ft. active surface, and 62 leaves are made up into a "basket" of 6,000 sq.ft. filtering surface. Twelve baskets formed the original installation, and two or three more are being built in the company's shop.

The layout required each third tank to be a "loading tank," with a "replacement tank" and a "blow-off" tank alternating. In practice this is sometimes modified, but the change always adversely affects the results. The loading tanks are provided with air lifts, one from the bottom of each pocket discharging above the surface of the pulp, to keep the slime constantly agitated. Each basket is connected by a 3-in. hose and valves to both the vacuum and compressed air headers, so that either can be used as required.

A typical cycle of tailing filtration is:

1—Basket lowered into loading tank by crane; vacuum applied and 30 to 35 tons of slime cake formed on the leaves, usually in about thirty minutes, the effluent liquor going to the strong-solution tank.

2—Basket hoisted and transferred to replacement tank and water drawn through for about fifty minutes to displace pregnant solution in the cake, the effluent going to weak-solution tank.

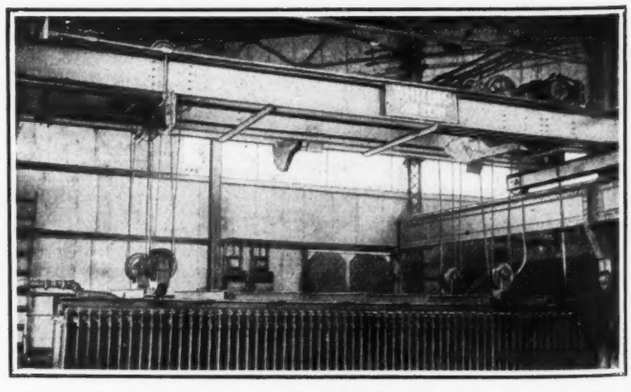
3—Basket transferred to "blow-off" tank, compressed air admitted and cake blown off, discharging to tailrace through spigots in the bottom of the pockets. An automatic tailing sampler removes a sample before the slime emerges from building. Time, about fifteen minutes.

The total cycle is from 100 to 120 minutes; capacity averages between 360 and 420 tons of tailing per day per basket. As near as I have been able to analyze the costs, primary slime filtration cost is about 27c. per ton and tailing slime filtration about 4.8c. per ton. The total cost of all filtering is approximately 6c. per ton of mill feed at 90 to 100 per cent of tonnage capacity.

In the mill layouts considered before the final plan was adopted, continuous filters were contemplated, but I am pleased to say that the Moore filters installed are operated under conditions that would be practically impossible for the continuous type and are giving excellent service. Filtering requires one operator for each crane, but two or three additional men are employed in the mill on the day shift in building and repairing filter leaves.

Sand Leaching Not an Unqualified Success

Six leaching tanks, each 60x16 ft., are provided with standard-type filter bottoms and one central and four side-discharge gates in each tank. Sand distribution is accomplished by Butters-type ball-bearing distributors supported on overhead tracks. After sluicing out, the tanks are filled with mill solution before sand is admitted. At present about 900 tons of sand is treated per day at full tonnage. The capacity of each leach tank is 1,680 tons. It requires 1.87 days to fill a tank, and about one day is lost in sluicing out a tank and filling with solution, leaving about 8.3 days for treatment in an 11.2-day cycle. Aëration by admitting compressed air below the filter bottom is practiced. Vacuum is also applied to increase the effluent rate, particularly toward the end of the treatment.



Moore filter basket suspended from transfer crane

The "table tailing" screen diagrams (Fig. 2, in Part I) indicate about 20 per cent of the sand to be finer than 150 mesh, and this fine material works down toward the bottom and checks the leaching rate. It also causes a loss of soluble values by carrying entrained rich solution to the tailrace when the tank is discharged. The diagram also shows from 15 to 20 per cent of +35-mesh sand which is too coarse to leach and therefore contributes its quota to the tailing loss. The remedy for these difficulties, in my opinion, is first to deliver to the fine-grinding department 0.25-in. mesh material and, second, to correct the flow sheet so that no coarse sand or sand too fine to leach will be received by the concentrating tables; in other words, to exclude from the concentrating floor sizes outside a range between —35 and +150 mesh. This would probably mean that some —150-mesh sulphides would reach the tables, but a part would be concentrated out; the small quantity remaining would not interfere with leaching, although it might not yield its values any better than it does now.

No Complications in Mechanical Equipment

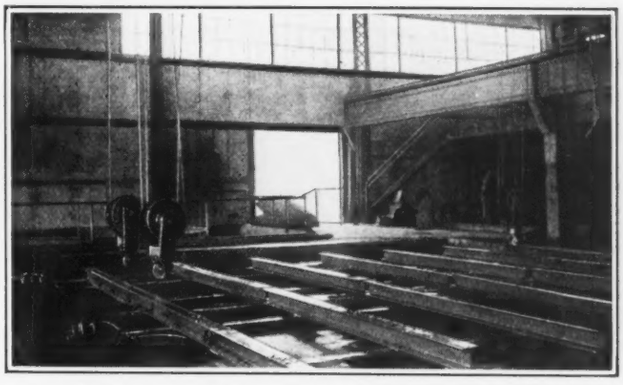
The mechanical equipment of the cyanide plant is simple. Excepting the agitators and thickeners in the concentrate treatment plant, each agitator and thickener has an individual motor drive and speed reducer. The speed reducers, different in type from the others used, have given some trouble. Three slow-speed line shafts operated at 60 r.p.m., direct-connected by Foote Bros. spur-gear reducers to 900-r.p.m. motors, drive the diaphragm pumps and concentrate treatment machinery. They have given no trouble.

Most of the solution pumps, the air compressors, and vacuum pumps are grouped compactly in a pump room 64x100 ft. in area. No troubles in operation due to design or machinery developed. Two or three accidents to the dry vacuum pumps occurred at first, owing to inexperienced operators allowing water to get into the vacuum lines. The connected load aggregates 570 hp. in this room and approximately 700 hp. altogether in the tank house. The current consumption in a recent month was 4.72 kw.-hr. per ton of mill feed, with a load factor of 81.3 per cent. This includes lighting. The labor employed amounted to 0.093 man-shift per ton of ore, including repair and shop men, precipitation, melting, and heating.

Method of Mixing Cyanide

The Aero brand of cyanide used as a solvent is mixed in two outdoor tanks (16x12 ft. steel) to minimize the danger from hydrocyanic acid gas generated when this salt is first dumped into water. Each tank is equipped with a 48-in. Devereux propeller agitator. The tanks are used alternately to mix and aërate the solution. The stock solution is standardized at 100 lb. sodium cyanide per ton and is piped to several points in the tank house where cyanide is added to the mill solution. Steel tubs 36 in. in diameter by 30 in. deep are used to measure the stock solution. Milk of lime is piped to the same points.

The consumption of sodium cyanide is about one pound per ton of ore treated; zinc dust, 0.18 lb.; litharge, 0.08 lb.; and lime, 16.3 lb. The cost of chemicals is about 23 per cent of the total milling cost at present, but other treatment costs will undoubtedly be gradually reduced for a long time yet. The total power consumption for the entire plant is 15.3 kw.-hr. per ton,



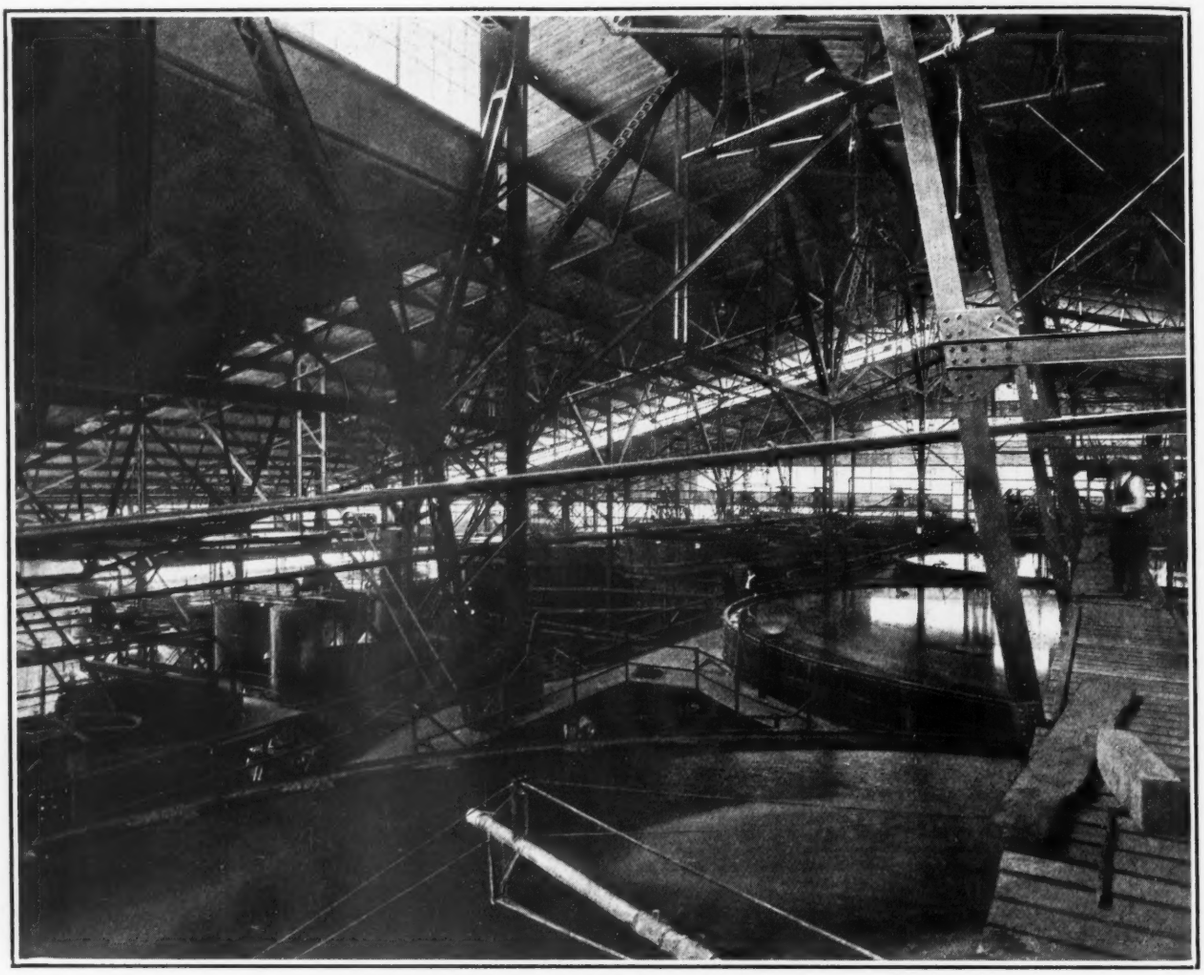
Moore filter plant, showing top frames of submerged filter baskets

and total labor (including superintendence) is 0.0695 man-shift per ton, divided 78 per cent to operatives, 12.5 per cent to repair men, and 9.5 per cent to shop men.

The pregnant solution, after being clarified by the Moore filter, passes from storage tanks to Crowe vacuum receivers, to the effluent of which zinc dust is added, and the solutions (weak and strong) are then pumped to Merrill filters in the precipitating room. The Merrill equipment consists of four presses, each containing thirty-two 42-in. triangular plates. Three presses handle the strong and one press handles the weak solution; 97 to 98 per cent of the values in the strong and about 90 per cent in the weak are precipitated. All the weak solution has to be wasted, but part is first used as a replacing wash in filtering primary slime; part as a wash in leaching tanks, and the remainder is wasted directly.

Recent practice has fixed a cleanup and melting at five-day intervals. The precipitate is scraped from the filter cloths and falls directly into a car underneath, which, when loaded, is run to a track scale, and the weight and approximate moisture are obtained. The amount of flux is calculated and weighed into the car before it leaves the scale. The track extends over the top of the reverberatory melting furnace into which the fluxed batch is shoveled through an opening in the reverberatory arch. The furnace, using fuel oil, is customarily fired when the cleanup starts, and a gentle heat is maintained to dry out the precipitate as it accumulates on the hearth. When the charge is complete, which is likely to be late in the afternoon if the cleanup started in the morning, the heat is increased slowly to sinter the charge. This continues all night, and the following morning the heat is increased and the melt completed by 1 or 2 o'clock. The slag is tapped off, and the bullion poured.

The bullion bars are nominally 2,000 oz. each. The doré fineness varies from 990 to 998. About 25 per cent of the bullion value is in gold; the silver is computed at 65c. in this article. The cost of melting is about 0.6c. per ounce doré bullion. The melting furnace has been favorably commented upon by visiting engineers and drawings of it have been requested by a number of them. It is a modification of a furnace the drawings of which we received from Frank P. Royer, and was used in Mexico at one of the properties in his charge. The size of the hearth was changed to suit our conditions, as were also a number of the constructional details. The hearth is mounted on a four-wheel truck and is removable for repairs. The hearth can be tilted if desired. The furnace could be improved, and



View in tank house. Leach tank in foreground

before others are built certain parts should be redesigned. The stack becomes too hot and the hearth-tilting mechanism is too slow for a tilting hearth and needlessly elaborate if the hearth is to be lowered and withdrawn only when cold. The furnace in question made 38 or 39 melts before the reverberatory arch needed replacing, and one new hearth has been put in. The first cost of the furnace and stack was about $5,000. Its capacity ranges from 40,000 to 50,000 oz. per melt. The slag is very clean and is sent through the mill with the ore. The slag-pot "skulls" are remelted with the succeeding cleanup. Dust losses, if any, have not been determined. There is a small dust chamber between the furnace and the base of stack, but it is not large enough to be effective.

Auxiliary Power Plant

To provide power to keep the thickeners, agitators, and main solution pumps in operation during power interruptions an auxiliary power installation is provided in the substation building. This consists of two eight-cylinder marine-type Sterling gasoline engines (1,200 r.p.m.), each direct-connected to a 90-kw., 2,300-volt generator and exciter. The starters are of the automobile type. No emergency requiring their operation has as yet occurred, but the unit is started up and exercised occasionally.

Acknowledgment is made of the courtesy of R. H. Channing, Jr., in permitting me to publish these notes.

Electrolytic Recovery of Zinc

An article in the *Zeitschrift für Elektrochemie*, 1923, Vol. 29, pp. 557 to 570, has been abstracted in *Chemistry and Industry* as follows:

The leaching of a roasted Swedish zinc ore was carried out in two stages as usual, the second stage involving complete neutralization of the solution from the first stage by means of a slight excess of the roasted ore. In this operation the bulk of the impurities was removed by the addition of lead peroxide to the neutralized solution in contact with excess of zinc oxide or by bubbling ozone through the liquid. Lead, copper, and cadmium were then removed by means of zinc dust, and the purified solution was electrolyzed at a current density at the cathode of 2.6 amp. per square decimeter with an e.m.f. of 3.5 to 3.8 volts per cell. An aluminum cathode and an anode of electrolytically refined lead were used, and electrolysis was continued until the solution, which contained about 60 to 70 g. of zinc per liter at the start, had been stripped of about half its zinc content. The current efficiency was about 75 per cent and the loss of lead from the anodes about 0.8 to 1 per cent of the weight of zinc deposited. The zinc deposit could be readily removed from the aluminum cathodes, and it is suggested that this was due to an internal stress in the zinc caused by recrystallization. Addition of glue to the electrolyte appeared to have no effect. The decomposition voltage of zinc sulphate was 2.62 volts, against a theoretical figure of 2.53 volts.

Oil Possibilities of Panama

A Review of the Recent Activity of Independent Producers

By John F. Sheridan
Consulting Engineer, Panama

REASONS why independent oil companies are becoming active in Panama may be summarized briefly as follows:

1. The ready market at the entrances to the Panama Canal. Practically all ships going through the Canal take on oil either at Balboa or Cristobal. Oil tanks are maintained at either end by the Union Oil Co. of California, the Huasteca Oil Co., the Texas Company, and the U. S. Canal Commission. The Atlantic and Pacific tanks will eventually be the supply points for distribution of oils to the east and west coast ports of South America, and for redistribution to interior cities of Latin America.

2. Panama petroleum, when produced, will have only short pipe-line runs to a ready market at canal approaches. Furthermore, the establishment of topping plants, refineries, and the manufacture of the products and byproducts of petroleum will eventually take place in Panama, to avoid the long and costly sea-haul of these essentials; and because the logical distributing center for the South American ports and cities must be Panama.

3. Panama on its longest length is only 535 miles long and is from 32 to 128 miles wide. From either side of the Canal 10-mile strip, a short pipe line can and will bring the crude oil to the Panama Canal tanks.

4. Panama has liberal oil laws and an abundant supply of labor.

5. Panama has a stable and secure government, proof against all petty and political revolutions and upheavals. This is insured by the military and naval precautions taken by the United States Government.

George H. Bevier, a geologist who visited Panama in 1917 and 1918, wrote the following brief description of the country:

"A number of broad stream valleys are to be found, which mark the separation of prominent mountain ranges, the Sixiola River valley being the most prominent of the group. Its current is rapid but navigable for small cruising boats, for a distance of about 20 miles. Direct navigation with the sea is limited to light dugout canoes, or cayugas, on account of the shallow bar mouth of the river.

"Headwater and mountain stream drainage descends at a rapid rate, revealing to the explorer many beautiful water falls, capable of supplying enormous power.

"Climate and rainfall vary according to location and altitude. The temperature along the coastal country and vicinity ranges from 70 to 95 deg. F. The rainfall in the same district varies from 100 to 150 in. per year, occurring in the spring and summer months. The climate is healthful and pleasant along the coastal districts, malaria being the prevalent disease. However, this is largely overcome by proper screening and sanitation. Along the higher altitudes, especially at San Jose, Costa Rica, is to be found an exceptionally healthful climate.

"The chief industry is the raising and exportation of bananas, cocoanuts, and tropical fruits. Northern Panama is sparsely settled with a mixture of negroes and Indians, the prevailing language being Spanish. Along the Caribbean coast there is to be found a number of small towns or settlements, the most important of which are Bocas del Toro and Almirante, shipping ports for the United Fruit Co. This company employs a large managing force, principally Americans.

"In age the sedimentary rock formations of the Caribbean coastal area range from recent deposits to those of Eocene age, and correspond to similar formations found in the Gulf coast and California oil fields of the United States. Rocks of the interior mountain districts consist largely of steeply dipping strata, highly faulted and cut by igneous intrusions and volcanic flows. Structural geology shows the presence of a number of anticlines, all having a general parallel strike of about 55 deg. W. Many of these anticlines, especially of the interior, have steeply dipping sides and are more or less faulty.

"The most important anticline of the group strikes along the edge of the coastal territory, a small portion of which is shown at Monkey Point, Costa Rica. This anticline extends to the southeast, passing through Columbus Island, Provision Island, and Valiente Peninsula, where it disappears into the sea some distance below. Inequalities occur in the anticline, which render portions of it more favorable than others for the accumulation of oil or gas. Columbus Island was found to be one vast dome, the centre of which was approximately the centre of the island. The sides of the dome extend for some distance into the sea, as was proven by structural readings on a group of small islands about one mile to the north. Other portions of the anticline are less favorable, as the result of having been cut by faults and igneous intrusions. Favorable structure was also found along the northwest portion of Valiente Peninsula, though not so strongly developed as that of Columbus Island.

"The attention of oil prospectors was attracted to this territory through the presence of an oil seep along Uscari Creek, a short distance above its junction with the Amouri rivers. A heavy dark green oil, having an asphalt base, may be found oozing out of the ground along a fault plain on the east side of the creek. On the strength of this showing a well was drilled to a depth of about 800 ft., one mile west of the oil seepage. Difficulty was encountered in drilling a straight hole owing to the steeply dipping formations. Favorable showings were not found. Gas seepages are to be found at a number of places, the most prominent occurring on the Yorkin River and tributaries near its junction with the Sixiola River.

"Several years ago the Panama Government drilled a well in Bocas del Toro in an effort to secure an adequate supply of pure water. They were unsuccessful in obtaining a satisfactory water supply, but found small amounts of natural gas. A second location was made on the southern portion of Columbus Island and similar results obtained. Detailed information regarding these wells could not be obtained, but it is reported that a depth of 1,080 ft. was reached. The Sinclair Gulf Corporation started drilling operations on Columbus Island in the fall of 1918.

"The presence of such favorable structure as was found on Columbus Island, together with the presence of oil and gas seepages in the interior, speaks well for this district in regards to its prospects for the future production of oil or gas. It is the belief of the writer and other geologists of the expedition that oil or gas should be obtained. However, an actual drilling test alone can reveal the quantity and character of the deposit.

"Nancys Cay lies along the southwestern slope of the anticline. Its structure, however, has not been worked out in detail, but is regarded as favorable."

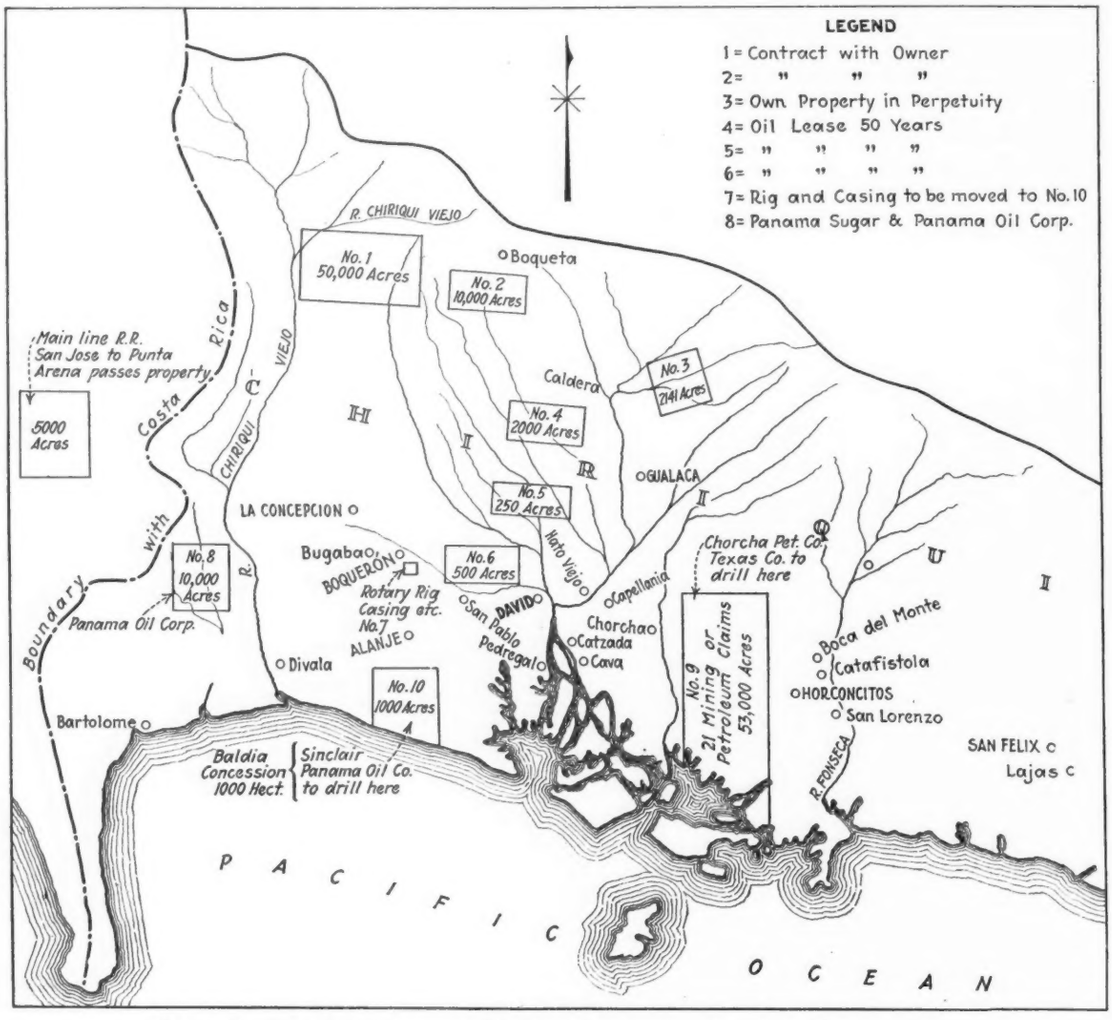
The report of the late G. S. Rogers, of the U. S. Geological Survey, describes the local structure around Bocas del Toro as follows:

"The rock outcroppings on Solarte and Columbus Islands and on a part of Provision Island which lies just north of Solarte are Tertiary sediments, probably of the Oligocene age. The rocks exposed consist of limestone and shell-rock of calcareous shale and sandy shale, all of which are characteristically massive and thick-bedded. The limestone is chiefly gray to yellowish gray in color and weathers to a cavernous surface, but a harder bluish limestone, probably lower in the section, outcrops on Provision Island. The shale and sandy shale are bluish gray, weathering to a brownish color. Many of the strata contain hard argillaceous concretions. These beds generally dip at angles less than 5 deg. and in many places are almost perfectly flat.

"This series is underlain by an upper Cretaceous or lower Tertiary formation, which is exposed only on the

mainland. The contact between the two formations is unconformable. The lower formation includes strata which are possible source rocks of oil, and which apparently give rise to the oil seeps that appear on the mainland between the region of Bocas and the Talamanca district in Costa Rica. These beds, however, are generally tilted at high angles, and the geologists of the Sinclair company have evidently worked on the theory that whatever oil these beds contained has migrated up into the basal strata of the overlying and less disturbed formation and has collected in areas in which the structure in this upper formation is favorable. Solarte and Provision Islands apparently represent a general uplift in the upper formation, and may therefore be considered broadly as prospective oil territory."

Dr. Veatch stated that in April, 1923, a contract was ratified with the Sinclair company by Dr. Belisario Porras, the President of Panama, granting the company approximately 700,000 acres of prospective oil land in the Darien region, and that he had Mr. Terry in charge of the Sinclair field force, reporting on and examining this area at that time. With the acreage already acquired, the Sinclair holdings in Panama will approximately total 1,225,000 acres. Dr. Veatch stated that Panama structures were very promising for oil production, especially in the Darien region; that any production brought in was close to a ready market at the



Map of part of Province of Chiriqui, Panama, showing oil properties

The Sinclair Oil Co. has two holes down on Columbus Island in Almirante Bay, in the northeastern province of Bocas del Toro; both wells are cemented and capped in. In a two-hour conversation with the head geologist, Dr. A. C. Veatch, last September, he stated that Panama had a broad sedimentary belt extending through Chiriqui and Veraguas to the Panama Canal Zone line on the west, and from the eastern line through the province of Panama and the Darien region into Colombia with structures in the Tertiary and Cretaceous formations. My own examinations have shown marine fossils, marls, limestone and oil-bearing shales in abundance in both provinces of Chiriqui and Panama generally, and the Darien region in particular. The presence of marine fossils inland in the Darien indicates that portions of the district were once covered by the Pacific Ocean. Canal; that the Panama Government was stable and liberal in its dealings with oil-producing companies, and that, in fact, Panama had the most liberal oil laws of any country in Latin America today.

According to Dr. Veatch, the Sinclair company had acquired 326,000 acres more in the district of Pinogana, Darien region, Province of Panama. Its new holdings are in one block, embracing a very large area of the Tuyra and Chuquinari River basins and tributaries of these rivers; the other three areas owned by this company are located as follows: No. 1 in Bocas del Toro, in which the company has two holes down and capped, on the dome of Columbus Island in Almirante Bay. Area No. 2 runs to the northern and eastern boundary of the Panama Canal line and embraces the rivers Piña, Punta Grande, Legarto, Salud

and Tecucal, and located between 9 deg. 8 min. North Lat. to 9 deg. 20 min. North Lat. and 80 deg. West Long. to 80 deg. 20 min. West Long. Area No. 2 extends along the Pacific Ocean in the Province of Chiriqui from 82 deg. 20 min. West Long. to 82 deg. 45 min. West Long. and from the Pacific Ocean running north at Bartolomo to Cuervo; thence northwest to Puebloviejo; thence directly west to the Chiriqui River, and directly south to the Pacific, bordering on the Chorcha Petroleum Co.'s twenty-one mining titles covering 53,000 acres, which the Texas Company controls through 51 per cent ownership in the Carib Syndicate of Maine.

The Texas Company loaned its attorney, Sr. Pedro Luna y Parra, to the Carib Syndicate to sign up the contract and oil lease on the Chorcha property last year. I was and am still the official agent for the Chorcha Petroleum Co. and claim to have been the first to dig for and bring seepage oil out of the Chorcha Oil Co.'s holdings in Chiriqui and also from the Darien region of Panama. The Chiriqui Oil is a high-gravity oil, asphalt base, and though the Carachina oil is similar to the Panuco Mexican product, the oil found in Pinogana is similar to the California oil and runs about 38 deg. Bé.

The Carib Syndicate of Maine, in which the Texas Company holds 51 per cent of the total stock issued, controls considerable acreage in Panama in the provinces of Chiriqui, Veraguas, and Panama. The Texas Company at the present time is drilling on the Sinclair holdings in Chiriqui on a well-defined structure about six miles from a small town called Boqueron; and is obligated by leasing contract to drill on the Chorcha Petroleum Co.'s twenty-one mining claims, containing 53,000 acres, located east of David and between the Chorcha Mountains and the Pacific Coast.

The Texas Company made a very peculiar mistake in locating and drilling a well between the Chiriqui and the David rivers about three miles east of "Las Trancas." It set up the rig and started making hole, only to find that it was drilling on the concession granted to the Sinclair company. A drilling arrangement was thereupon entered into by the Texas Company and the Sinclair interests.

The Gulf Oil Co., through the Panama Gulf Co., has been drilling for some time on a well-defined structure, located about six miles from the town of Garachine, in the district of Chepigana in the Darien region, along a line of well-developed oil seepages. It is down in a hard lime formation and is about to set and cement in an 8-inch casing. This well was drilled with rotary tools. The bore is located between two rivers on a line of oil seeps and on favorable structure; there is no doubt about the petroliferous possibilities of the Darien region, as there are all of the well-known surface indications, such as asphalt deposits, oil seeps, mud volcanoes, and oil scum on one river higher up, with one spring showing oil on surface in fair quantity in the Pinogana district. The property on which the well that has been drilled is located is known as the Darien estate, and is owned by Dr. Sylvanus M. Pearman, of Rochester, N. Y. The tract is 19 miles by 30 miles; in 1911 over 50,000 acres was denounced and taken up by twenty-one men, mostly Americans. The owner, Dr. Pearman, claimed the subsoil rights under the old Roman law and won a decision in the Supreme Court against the twenty-one American holders of the mining rights on this tract.

The Standard Oil Co. of California has opened offices on the Avenida Central in Panama City, with a large field force in charge of Mr. Montgomery, manager, and Dr. George Nomland, geologist. Dr. Nomland copied my maps of the Darien region showing possible petroliferous areas and was much interested in the data I turned over to him relating to this region. In an interview, the manager of the company stated that he was leaving for a trip to Ecuador to look over the oil possibilities in Santa Elena and Punta Sentinela (Sentinel Point). Here a number of bores are completed and others are drilling shallow wells. A great number of oil pits are producing oil in quantity.

The Royal Dutch has oil holdings in Panama, and also the British Controlled Oilfields, Ltd., but up to the date of writing neither has done any drilling.

Of the Indian tribes encountered by the oil prospector and explorer, the Kama Indians are the most warlike and, to date, will not allow any white man or native above the Membrillo River on the upper reaches of the Chuquinaki.

What Is the Biggest Nugget?

By R. Gentum

WHAT is the biggest nugget on record of silver or gold? Not so long ago a 3,200-lb. mass, assaying 8,000 oz. silver a ton, was marketed by Anton Clement. It came from his claims in the Gillies Limit, Cobalt district, Ontario.

The famous Lawson vein, or "silver sidewalk," of the Kerr Lake mine yielded several million ounces. It ran 2,000 to 14,000 oz. silver across a width of 4 to 14 in. It was called the "silver sidewalk," because the surface outcrop, when stripped and cleared, and revealing the lane of native silver, often over a foot broad, really resembled a silver sidewalk. But it was not nugget silver; it was only rich vein matter. So, too, are only vein matter the 1,200-lb. mass, assaying 8,000 oz. a ton, from the Frontier mine, at South Lorrain, 18 miles from Cobalt, and the even larger mass from the Keeley mine, at South Lorrain. The Frontier mass is to be on exhibit at the British Empire Exhibit in 1924; the Keeley mass is on exhibit in Canada. It was too heavy to move to London.

That those exhibits are not nuggets, proper, nor masses of pure nor nearly pure metal, is easily perceived when it is considered that 29,166⅔ oz. troy are in a short ton, of 2,000 lb. avoirdupois.

The largest nugget or isolated chunk of pure or nearly pure silver on record is a mass weighing 1,750 kg., or 3,850 lb., or 1.9 short tons. It would contain 36,146 fine ounces troy if pure. It was reported in 1907 by the Italian *Rassegna Mineraria* after the Austrian *Zeitschrift f. Berg- u. Hüttenwesen*, as having come from the Gibson mine, at Aspen, Colo.

Really, however, the record seems to be a mass of 18 metric tons, or 39,600 lb. avoirdupois, that came from the Calaverita mine, in eastern Durango, Mexico. It ran 75 per cent silver, and was so nearly pure metallic silver (which is noted for its soft ductility and malleability) that it couldn't be blasted, hammered, or broken. It had to be cut with knives and saws. The Durango nugget is chronicled by A. Terrones in the *Mining Journal-Press*, Vol. 113, 1922, page 1602.

Flame Test for Copper an Aid in the Study of Croppings

By Charles Henry White
Consulting Geologist, San Francisco, Calif.

Charles H. White

IT IS well known that visible copper minerals in certain associations are useful guides in selecting ground to be prospected. On the other hand, there are other associations in which these conspicuous minerals should be a danger signal to the prospector. It is now known that copper in invisible form is much more abundant in mineralized croppings than in visible form, and although its mere presence does not indicate commercial ore any more certainly than do visible copper minerals, it is probable that if carefully studied with its associates, and the variation in quantity from place to place determined, it may help in the determination of the geological history of the deposit, particularly as to how far secondary enrichment has progressed.

Many hundreds of tests on croppings from numerous districts have given me the impression that a rock, once copper bearing, rarely loses all trace of its copper through weathering and leaching. Usually the amount remaining is sufficient to be estimated by the ordinary quantitative methods, if a large sample is used; but when the content of copper falls below a few tenths of 1 per cent, results by ordinary methods have proved unreliable.

Advantages of Flame Test

Early in my work on this problem, in connection with many other problems related to the study of croppings of copper ores, I turned to the flame test, which, though not quantitative in the accepted sense, is delicate, simple, rapid, and often serves to detect which of two samples carries the more copper, even when neither shows a trace by usual methods.

By the flame test results have been expressed only in a comparative way by noting the length of the blue copper coloration in the colorless flame of the bunsen burner or spirit lamp, using as large and uniform assays as possible on a platinum wire. In an effort to standardize the flame test and make it possible to express the results in approximate percentages, I have carried out the experiments described below in the laboratory for metallurgical chemistry of Stanford University through the kindness of Theodore J. Hoover, professor of mining and metallurgy and executive head of the department.

Before describing the experiments the following observations on the copper flame should be made: The copper flame consists of a blue corona, or envelope, about and in contact with the assay, which makes its appearance even before the percentage of copper in the assay is as high as one one-thousandth of 1 per cent. As the percentage increases the blue envelope thickens, especially on the upper side of the assay, until it is about one-half inch long, when blue or green flashes of color appear on the outside of the gas flame. As the copper in the assay further increases, both the inner flame and the outer envelope increase in length, the envelope turning more green as the copper increases, until the whole length of the flame is green, masking completely the inner blue flame after it has reached a length of about two inches.

The length of the copper flame apparently depends upon the amount of copper that is being volatilized at the moment of observation, and this depends upon the amount available upon the surface of the assay, either there originally or brought in solution by capillarity while the assay is in the flame.

Standardizing the Flame Test

A weighed quantity of pure crystallized copper sulphate was dissolved in water and diluted to a definite volume. Portions were taken out with a pipette and diluted with measured quantities of water so that the amount of copper in a cubic centimeter was always known. Andesite, free from copper, ground to pass a 100-mesh screen, was held on the end of a platinum wire as a carrier of the copper solution. A platinum wire 0.4 mm. in diameter, and 6 cm. (2½ in.) long, with a loop at one end 3 mm. in diameter and the other end fused into a small glass tube 4 in. long, was used to hold the assay. The bunsen flame in which the tests were made was 20 cm. (8 in.) long. The platinum wire with its glass handle was weighed. The looped end of the wire was dipped into concentrated hydrochloric acid and then into the rock pulp and as much of the pulp as would adhere to the wire was held in the flame about twenty seconds and slowly turned in the hottest part of the flame until the whole mass glowed at the highest temperature attainable. The pulp sinters on the outside and clings to the wire in any position. After cooling, the wire with the assay was weighed, the increase in weight representing the assay. The assay was then gradually lowered into the copper solution in the following manner: The wire was curved near the loop and the curve depressed into the solution first so that the solution would run up the wire to the assay slowly by surface tension.

When the assay began to take up the solution it was quickly lifted out of the solution and then lowered and lifted in succession so that the assay would not be broken by the sudden rush of solution into it. When the assay had absorbed all the solution possible, it was weighed, the increase in weight representing the solution taken up, the copper in which was calculated, the amount per cubic centimeter being known. Evaporation while weighing, adsorption, and other causes of inaccuracy may be neglected, as the method is only approximate. The assay was then dried in the flame until the edges began to glow with heat. It was then allowed to cool for thirty seconds and carefully lowered into hydrochloric acid in the manner described above, after which it was held in the flame near its base and the length of the flame carefully noted.

The results of the first series of experiments are shown in Table I, the weights being in milligrams and the lengths in inches.

These results show that the smallest amount of copper that yielded a visible trace of color to the flame

was 0.0004 mg. This was held in 35.9 mg. of pulp, and therefore is 0.00116 per cent. The table also shows that the length of flame depends more upon the amount of copper in the assay than upon the percentage in the pulp which carries it and that a smaller percentage may be shown by taking a larger assay with the same amount of copper. It will be noted that weights of assays varied between 17.5 mg. and 111.9 mg. The variation was by design for experimental purposes. The average of the ten highest assays is 80 mg., and that is probably near what the average would be if an attempt were made to take as large assays as possible of material of this composition and fineness on a 3-mm. loop of wire of this size. In the last column in Table I the percentages of copper are given, based on assays of 80 mg. each. On this basis, the smallest percentage detectable would be 0.0005, or five parts per million. A graph drawn from the table shows that each one-tenth inch of flame indicates about 0.004 per cent copper.

Table I

No. of Experiment	Weight of Rock Pulp, Mg.	Weight of Copper Solution, Mg.	Copper in 1 c.c. Solution, Mg.	Weight of Copper in Assay, Mg.	Per Cent of Copper in Assay	Length of Flame, Inches. Blue	Green	Per Cent of Copper Based on 80 Mg. Assay
10	35.9	21.0	0.0199	0.00041	0.0011	Trace	...	0.0005
9	111.9	76.0	0.0199	0.00151	0.0013	Distinct		0.0019
8	28.8	16.0	0.1598	0.00255	0.0088	—.1	..	0.0032
7	17.5	15.1	0.3196	0.00482	0.0275	.1	...	0.0060
6	27.1	18.4	0.3196	0.00588	0.0217	.1	...	0.0073
22	66.2	46.5	0.2434	0.01131	0.0171	.4	...	0.0141
3	50.5	36.7	0.3196	0.01173	0.0232	.6	...	0.0146
20	49.7	33.4	0.3407	0.01138	0.0227	.6	...	0.0142
4	58.5	43.7	0.3196	0.0139	0.0237	.5	...	0.0170
5	73.5	46.6	0.3196	0.01489	0.0202	.5	...	0.0186
2	86.5	53.0	0.3196	0.01694	0.0195	1.0	...	0.0211
21	79.6	58.9	0.2869	0.01716	0.0215	.6	...	0.0214
1	64.0	53.5	0.3196	0.0171	0.026	1.0	...	0.0213
12	39.9	25.6	0.8519	0.0218	0.054	.5	1.6	0.0273
18	69.0	41.2	0.5679	0.0235	0.034	1.0	...	0.0290
19	98.7	60.9	0.4259	0.0259	0.026	.8	...	0.0320
16	79.6	49.0	0.5679	0.0278	0.035	.8	...	0.0340
17	71.7	40.9	0.8519	0.0348	0.048	1.0	8.0	0.0435
11	53.7	31.3	1.7039	0.0563	0.105	1.0	8.0	0.0700
15	56.4	35.0	1.7039	0.0596	0.105	....	8.0	0.0740
14	39.1	26.1	4.4343	0.1157	0.296	....	8.0	0.1440
13	43.9	29.1	7.9817	0.2323	0.529	....	8.0	0.2900

To compare these results with those obtained on materials carrying copper sulphides, I mixed weighed quantities of the rock pulp used for the experiments described above with known quantities of either chalcopyrite or bornite. In this experimental test the results as detailed in Table II, which follows, were obtained:

Table II

Per Cent of Copper in the Pulp	Length of Flame in Inches
0.025	0.2 to 0.3
0.05	0.3 to 0.5
0.1	1.
0.2	2.
0.4	3.

Copper in the form of sulphide does not volatilize so readily under the conditions of the test as it does when in the form of sulphate, and persists much longer in the assay under repeated treatments in the flame after dipping in hydrochloric acid. A graph drawn from the results in Table II shows that each 0.10 in. of flame indicates about 0.01 per cent copper, two and a half times as much as is indicated when the copper is in the form of sulphate. It also appears that a uniform size of assay is not essential when testing sulphides; the width of the flame is more affected by the size of the assay than the length.

The results obtained on materials containing copper as sulphide indicated that the determinations are comparable even if there is considerable variation in the quantity of pulp taken for the test, and that for rough approximations each 0.10 in. of copper flame indicates about 0.01 per cent copper in the rock that is the subject of the test.

The length of the copper flame can be more accurately estimated by the use of a Wratton H ray-filter. As the determinations can be only approximate, the experiments were carried out with simple apparatus under conditions that are easily reproduced under ordinary circumstances.

New Record Production and Shipments of Sulphur in 1923

FEATURES of the sulphur industry in 1923 were the agreement between the American and Sicilian sulphur producers regulating the world's sulphur market and the entrance into the sulphur industry of a new producing property, the Hoskins Mound deposit in Brazoria County, Tex., operated by the Freeport Sulphur Co., according to the U. S. Geological Survey. The production of sulphur increased from 1,830,942 long tons in 1922 to 2,035,847 tons in 1923 and the shipments increased from 1,343,624 long tons in 1922 to 1,618,841 tons in 1923. Both production and shipments reached new high levels in 1923 compared with previous records of 1,879,150 long tons production in 1921 and of 1,517,625 long tons shipments in 1920. The estimated value for 1923 is $26,000,000, compared with $22,000,000 for 1922, at approximately the same rate per ton.

Stocks, which amounted to nearly 2,500,000 long tons at the end of 1922, increased to nearly 2,900,000 tons at the end of 1923, practically 1.8 times the shipments in 1923, so that if production should cease entirely shipments from stocks could be maintained for nearly two years at the rate for 1923, which was the record high rate.

The exports of sulphur, or brimstone, in 1923 amounted to 472,525 long tons, valued at $7,105,260, compared with 485,664 tons in 1922, valued at $7,095,628, a decrease in quantity but an increase in value. The exports in 1922 were the highest ever made, and those for 1923 were second only to those for 1922 and 1920.

The production of pyrites in the United States in 1923 was 181,628 long tons, valued at about $661,000, compared with 169,043 long tons, valued at $671,241; in 1922, an increase in quantity but a decrease in value. Of the 181,628 tons produced 170,997 tons was either sold or consumed by the producing companies. Pyrites was produced in five states in 1923—California, New York, Ohio, Virginia, and Wisconsin. The combined production of California and Virginia was 170,300 long tons; New York produced 11,000 tons; Ohio, 138 tons; and Wisconsin, 190 tons. The mine of the Connecting Link Mining Co., Wisconsin, was operated only five months in 1923, as the mill was destroyed by fire on June 1.

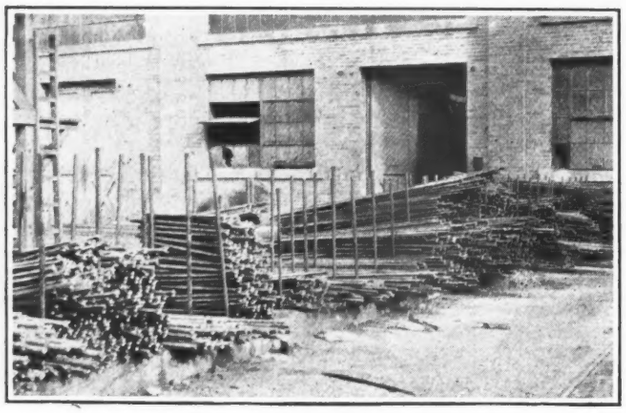
The imports of pyrites in 1923, practically all from Spain, were 259,721 long tons, valued at $1,242,574 compared with 279,454 long tons in 1922, valued at $1,199,101. About 4,000 long tons reported by the Bureau of Foreign and Domestic Commerce as imports of sulphur from Spain should undoubtedly be reported as pyrites. The Bureau of Foreign and Domestic Commerce is investigating these imports and the 4,000 tons will probably be added to the 259,721 tons given above as imports of pyrites.

USEFUL OPERATING IDEAS

United Verde Drill-sharpening Shop

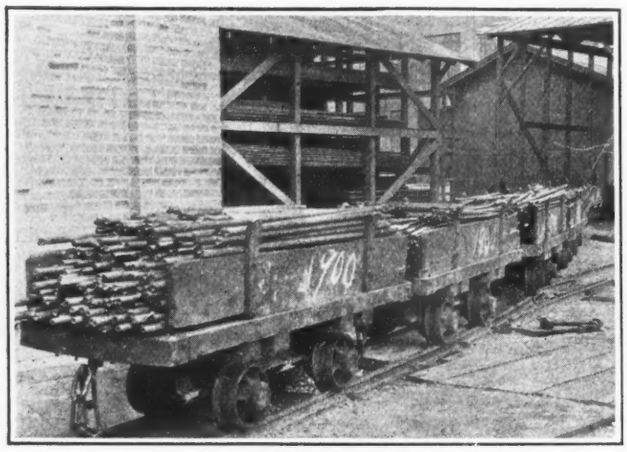
By George J. Young
Associate Editor

The drill-sharpening shop of the United Verde Copper Co. at Jerome, Ariz., is of interest to operators by reason of its simplicity of arrangement and the methodical way in which the work of sharpening is carried out. The shop is laid out symmetrically on either side



Drill racks for finished steels

of a center track, on which the dull drill steel is received in special cars from the mine and the finished steel is loaded into the same cars and delivered to the mine. The steel is distributed and gathered from the various levels in the same car, so that no rehandling occurs between the loading points and the shop or between the shop and the distributing points. Sharpened steel is loaded as it is finished upon a special truck and transferred to the tempering furnaces and, after tempering, it is reloaded into similar trucks and distributed in the finished-steel racks, which are alongside of the mine track outside of the shop. New steel is stored in racks outside and convenient to the entrance



Train of loaded drill cars

of the shop. The floor about the sharpening units is earth, and surrounding this is boiler plate upon which the flat-wheeled trucks are moved about. At the end of the shop area three tempering units are provided as well as two sets of emery wheels for finishing shank ends. Straightening of long steel is carried out at the lower right-hand corner of the shop (Fig. 2).

The shop equipment consists of six sharpening machines, each with its accessory furnace, punch, and anvil. The furnaces are oil fired, the steel being introduced into a narrow slot on one side, the other side being bricked up. The ends of the drills are supported on a steel stand in front of the furnace. A receiving rack is alongside each furnace. The drills are segregated into the various lengths, and the work of each sharpener is restricted to one length of steel. An anvil (Fig. 1) is provided at each unit, and cutting is done by sledge and hot cutter. All of the drill sharpeners are of the Ingersoll-Rand type, with the exception of one of the Waugh type, which is used solely for shanking steel. A sharpener is kept in reserve, and when one machine is in need of repairs it is replaced by the spare machine.

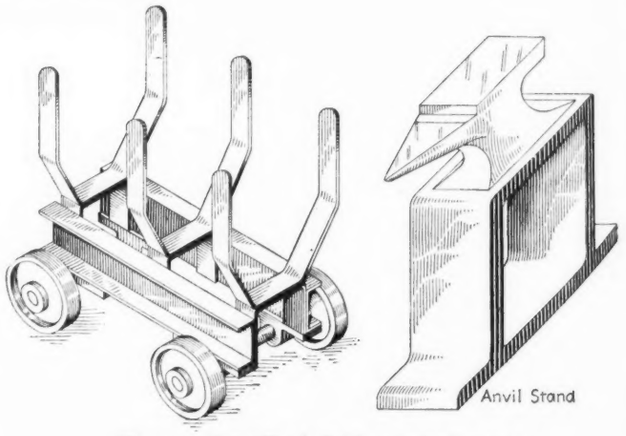


Fig. 1—Detail of drill car and anvil

Two men operate each unit, the helper handling the forge and the drill sharpener operating the sharpener. Drill steel is placed in a receiving rack and finished steel in a drill car. The operations are heating to a forging temperature, forging, punching, and blowing the hole in the steel. Where necessary a bit is cut off and the end of the steel reheated and forged. From time to time the drill cars are removed to the hardening units and the drills heated for hardening and plunging into cold water. The water in the tanks is circulated. Oil is used for quenching drill shanks after heating them to a hardening temperature. The oil is circulated and passes over cooling coils to keep it at a uniform temperature. After hardening, the drills are tested for straightness and trued where necessary and loaded into a drill truck. The finished drills are placed in the finished-steel racks.

Two sizes of drill steel are used, $\frac{7}{8}$-in. hollow quarter-octagon for jackhammers and stopers and 1.25-in. round hollow steel for drifters. The lengths of steel and bit sizes are given in the accompanying table. Bits are double-taper cross bits, the end taper of 5 deg., extending from $\frac{3}{8}$ to $\frac{3}{4}$ in., and a 14 deg. taper meeting the drill rod.

Standard Sizes of Drill Steel

Steel	Short Starters	Long Starters	Seconds	Thirds	Fourths	Finishers	Long Finishers	Extra Long Finishers
1.25 in. round, inches.....	12–18	18–27	27–36	36–45	45–54	54–63	63–72	Over 72
Bit gage, inches.....	1–$1\frac{1}{16}$	1–$1\frac{1}{8}$	1–$1\frac{1}{16}$	1–$1\frac{1}{4}$	1–$1\frac{1}{16}$	1–$1\frac{3}{8}$	1–$1\frac{7}{16}$	1–$1\frac{1}{2}$
$\frac{7}{8}$-in. quarter octagon, inches.....	12–18	18–30	30–42	42–54	54–66	66–78	78–90	Over 90

The work of the shop is in charge of a foreman. More than 2,200 steels are sharpened in an eight-hour shift. A recent month's record was 66,406 drills in twenty-eight shifts. The number of men for this work totaled twenty-five, or seven hundred shifts' work. A set of dies lasts about a week and a set of dies and fuller blocks is replaced every two days. The use of a $\frac{1}{16}$-in. bit gage necessitates the maintenance of dies and fuller blocks at a high point of efficiency. Experiments are now being conducted with an automatic tempering machine, and a semi-muffle type of furnace with automatic pyrometer heat control is to be installed for heating steel to the proper forging temperature. The result of experiments with both devices will be of considerable interest.

Acknowledgment is made of the courtesy of the United Verde Copper Co. in facilitating the gathering of the foregoing notes.

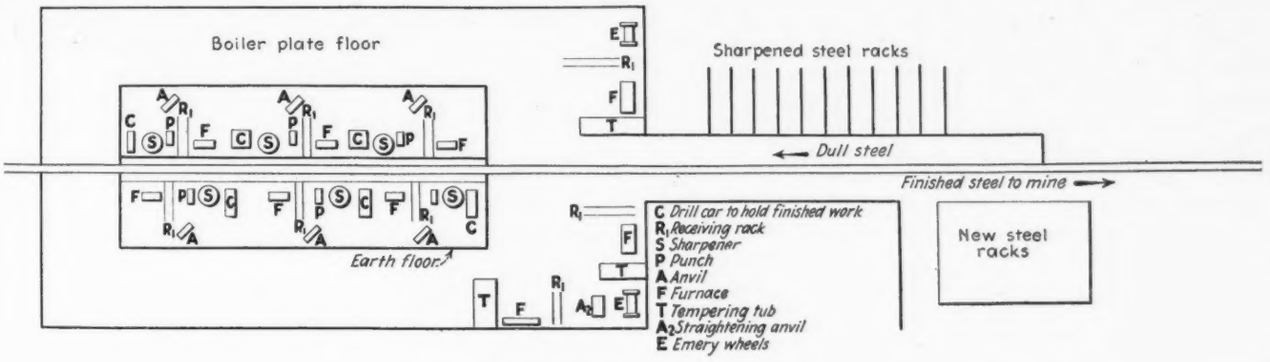


Fig. 2—Sketch plan of shop

Prevention of Accidents by Rotating Shafts

Every machine with a rotating part, according to Guy A. Barker in the *California Safety News*, has a shaft that is an integral part of the machine. Between the shaft and the prime mover there is generally one or more shafts whose function it is to transmit the power from the prime mover to the machine. Usual engineering practice, until the use of the direct-connected motor, was to drive all machines through transmission shafting and belting. This shafting was placed overhead on the building structure or under the floor, supported by the flooring structure. In either case, the shafting was apparently out of the way and harmless, and by reason of its position was not regarded as dangerous. However, many persons have been seriously injured by coming in contact with shafting. The man whose duty it is to see that the bearings are properly lubricated is the one who is most directly exposed to the danger, and in many cases too little attention has been given to making his task easy and safe.

It is possible practically to eliminate the danger in a well-designed plant. Where the shafting is installed overhead, runways should be made a permanent part of the structure and of sufficient width. They should be provided with hand rails and toe boards on both sides. The shaft should never be considered as a hand rail, because therein lies one of the principal sources of danger. The railings are designed to prevent a man from falling from the platform and from coming in contact with the moving machinery. If the runway is provided with hand rails on the side away from the shaft, only the oiler is inclined to consider the shaft as a means of support in case of losing his balance while on the runway. A railing should therefore be installed on the shaft side of the runway in such a way as effectively to prevent anyone from coming in contact with the shaft unless it be done deliberately.

Where the shafting is mounted beneath the floor the problem is different. Often the attendant has to work in spaces that are more or less cramped, and he is therefore in dangerous positions. As far as possible, no oiling of machinery in basements should be permitted when the machinery is in motion. If this is not possible there should be provided well-defined passageways with sufficient room overhead to permit a man to walk comfortably. They should be railed off from moving machinery in accordance with standards adopted for guarding machinery along commonly used passageways.

Where a passageway crosses under the shaft and it is impracticable to provide sufficient headroom the shaft should be boxed in at such points or provided with a loose sleeve. The sleeve should be free to rotate with the shaft, but should be so mounted that in case anyone comes in contact with it the sleeve will cease rotating, thereby eliminating the danger of anyone being caught on the shaft. It is preferable that this sleeve be made of metal, securely fastened around the shaft. As a convenient substitute, however, paper mailing tubes of the proper dimensions can easily be placed on the shaft and held in position with friction tape. This provides as satisfactory a safeguard as the metal tube, except that its life is not as long. It has the advantage of creating less noise in case the shaft vibrates appreciably.

DISCUSSION

"Engineering and Mining Journal-Press" is not responsible for statements or opinions published under "Discussion." In many cases the views expressed are diametrically opposed to editorial policy and belief.

The Prospector and the Land Office

THE EDITOR:

Sir—My attention has been directed to your editorial "The Prospector and the Land Office" in your issue of Dec. 29, 1923. I desire an opportunity to present the facts.

The case in question is Copper Mountain Mining Company *vs.* Hermansen, in which the United States appeared as intervenor for the purpose of protecting the Pinnacles National Monument. The trial lasted the greater part of three days.

In about 1870 the present president of the Copper Mountain Mining Co. discovered what is now known as the Melville mining district, in which these claims are situated. An "excitement" followed, during which at one time the district had a considerable population. Nothing of importance developed and finally all but this one man left. Claims were located and relocated, until about ten years ago the company appearing in this case acquired all ground claimed under mineral location, a group of twenty-six full claims.

The company was financed in England and approximately $28,000 was secured by the sale of stock in that country. Of this amount $15,000 was spent for the purchase of 160 acres of picturesque scenery known as "The Pinnacles" adjoining a government reservation set aside as the Pinnacles National Monument. The mining company has made a practice of charging tourists 50c. a head for crossing its ground to visit this monument and its representatives have even stopped automobiles and collected this sum long before they reached any of its claims and while they were still traveling the public highway. The company claimed, among other things, 160 acres as a townsite, notwithstanding the fact that there is no law authorizing it to acquire land in this way, and tourists who camped on this "townsite" without paying the 50c. fee demanded were ejected by threats and the display of weapons. In one case a man so ill that his health was seriously endangered thereby was so forced to move.

Of the remaining $13,000 raised in England, less than $2,500 can be accounted for in bona fide mining improvements, all made since the homesteader made known his intention of filing on the land. No satisfactory accounting was made of the remainder except for $2,500 stated to have been expended for a surface survey of the claims. Evidence was introduced to show that much of the remainder went into a road, but it was proven on the cross-examination of the company's own witnesses that this road was built many years ago by ranchers in the locality and that such maintenance as it has had has been to provide access to the Pinnacles and not for mining operations.

Reference to certified copies of location notices introduced by the mining company shows that had it done only the bare assessment work each year, making due allowance for exempt years, there should have been $33,000 worth of work on the claims at the time the homestead entry was filed. The return of its own mineral surveyor showed a total value of $10,710, of which $5,460 was for the road, leaving $5,250 for actual mineral development in fifty years. During no year was the assessment work for the entire group ever performed in full.

During the more than fifty years that these claims have been held, off and on, the only shipment alleged was of about ten tons, not made by the claimant in this case, which was sent to a man for experimental use to try out a new process with which he was working. Testimony on this point was indefinite, the exact weight and the value of the shipment not being shown. During all of this period the only revenue was that collected from sightseers wishing to view the Pinnacles.

This "worthy citizen" referred to refused to state under oath where he was born and whether he was a native born or a naturalized citizen of this country.

The company's expert presented testimony as to the assay value of samples taken by him, but admitted on cross-examination that these samples were not representative of the deposit. The "elaborate testimony" showing how these samples could have been tampered with was introduced because this man laid some stress on the means he had used to safeguard them against tampering, means which were shown to be inadequate.

The miner who has been employed under contract to drive tunnels since the homestead entryman filed admitted that he had seen nothing in either of the two tunnels that he drove to warrant the conclusion, from the viewpoint of a practical miner, that the ground has value for mineral.

The government intervened in this case because of various complaints that this company was not operating in good faith and was interfering with the public enjoyment of the Pinnacles National Monument. If you are really desirous of instances of "sympathetic co-operation between the Land Office and prospectors" they can be found by the dozens. This has been the case particularly in conflicts between prospectors and railroads holding land grants. Here, time and again, the General Land Office, and the Forest Service as well, has sent its men into the field, made detailed examinations and samplings, furnished the attorneys to try the case and paid the prospector a per diem fee and mileage for coming into court to save his own claims. Is this your idea of a "ruthless machine that . . . wipes out a going prospect"?

In another editorial in the same issue of your magazine I read "we do wish to save investors from hopeless and fantastic schemes." The General Land Office occasionally has to bring actions to accomplish this selfsame purpose, and its intervention in this case was because it was felt that this scheme was in that class and that

money would be saved to prospective investors as well as the National Monument protected by its acts.

This course was decided on only after three different engineers reached the same conclusion. The president of the company accompanied the government witness referred to in the editorial throughout his examination and at the conclusion expressed his satisfaction with the way it had been made and the samples were taken. The case was originally set for February, 1923, at which time all parties except the plaintiff appeared. The defendant and intervenor agreed to a continuance while a messenger was sent to notify the president of the company and even then he refused to appear and prosecute the action and offered no explanation of his refusal. Decision by default was then rendered against the mining company, which, of course, lost all standing as a litigant by its action. Nevertheless, on its appeal, the entire matter was reopened so that it might have a full opportunity to present its case. Does this indicate a "ruthless machine that works by formula"?

San Francisco, Calif. J. H. FAVORITE,
Chief, San Francisco Field Division,
U. S. General Land Office.

Somewhere in the Field—Treat 'Em Rough

THE EDITOR:

Sir—A recent experience tempted me to write what has been on the mind and chest of many a mine superintendent, manager and foreman who has wanted to deliver the goods, under all circumstances.

Some of us are in the field because we lack financial ability. A man I know has acted as mine manager, superintendent, etc., for over twenty-five years. He is sober, honest, fairly able, touchy and enthusiastic over his work. He has been in direct charge of mining properties that have paid during his management, or superintendency, many millions of dollars. Such a man ought to be wealthy—but he's not. Many times he could have been by adopting methods that did not agree with his ideals.

This man recently, on very short notice—two days to be exact—sailed away to a foreign land. He has in a few months made substantial profits for his principals, by enlarging the scale of operations. His salary has been ample, but he has not been treated as he thinks he should.

Supplies have been slow in coming, his expense accounts have been scrutinized very carefully, he has been treated "hard," not "liberally." He started on his work, full of enthusiasm. Several hard-boiled remarks in letters, several "jolts" from the home office have changed his attitude toward his work.

This calls to my mind similar experiences of my own. Office men, perhaps owners, have not taken into consideration the loneliness, the troubles, the idiosyncracies of the life of the field engineer. If a man earns $20, $50 or more per day, why quarrel over a $5 expenditure he saw fit to make. If he piles up these $5 or $10 expenditures, why worry him about them, if he is making good otherwise.

If I were a financial wizard, desirous of mining at a profit, I should give my field men an expense allowance and split with them what they save from it. If the allowance needed increasing I should increase it.

Mining engineers, with much continuous field work to their credit, get to be moody, cranky boys. They need encouragement, jollying, not captious criticism.

At present I am working for a man who puts up and shuts up. He is getting big profits but I wish he would say *something* once in a while. I need human contact with him. If he should merely dictate a letter like this "You have been doing a lot of good, hard work for me and I appreciate it. I am so busy it has been impossible to write often. When you get this, try to knock off a few days and go to the capitol and rest up. Send the whole bill, amusements and all, *unitemized*, to the cashier for credit to your account."

Say, Mr. Editor, if I got a letter like that (between ourselves I ought to) I'd work harder than ever and probably wouldn't take the trip suggested.

BOTRYOIDAL BILL.

Origin of Petroleum

THE EDITOR:

Sir—In the *Mining Journal-Press* of March 1 Hiram W. Hixon criticizes your recent article on ore magmas, and attempts to prove that petroleum cannot be of organic origin, and the only alternative is that it is essentially a magmatic differentiation product. I am not concerned with Mr. Hixon's conclusions or opinions on the much-discussed question as to whether petroleum is of organic or inorganic origin, or possibly of both; I wish, however, to point out that his argument against its "organic" origin is valueless because based on false premises—to wit, that organic matter necessarily contains oxygen, and that the distillation products of cellulose and coal necessarily contain oxygen. Many of the products of coal gas retorts contain no oxygen, and the most cursory examination of a list of the formulas of organic compounds will show that a very considerable proportion of them are composed entirely of hydrogen and carbon (the hydrocarbons) or of these elements plus nitrogen. Even turpentine, which he cites, is practically free from oxygen.

Mr. Hixon quotes "artificial tar" as 4.4 per cent oxygen, this being presumably a product of bituminous coal. He ignores, however, the fact that a fractionation of coal tar yields a long series of "organic" products many of which contain no oxygen, such as benzene (C_6H_6), naphthalene ($C_{10}H_8$), anthracene ($C_{14}H_{10}$), and aniline (C_6H_7N). In fact, one of the most important distillation products obtained by heating wood (cellulose) or coal in a retort is methane (CH_4), the lowest of the paraffin series of hydrocarbons, which is so often found where organic matter, especially cellulose in the form of leaves and roots, is decomposing in the mud of a marsh or river bed. The historic mural painting of the early chemist Dalton shows him in the act of collecting this same marsh gas from a pool. A much quoted analysis of "wood gas," obtained from a retort, states the percentage of CH_4 as 15; retort coal gas usually contains much more (30 to 50 per cent), besides other hydrocarbons.

As regards the deoxidation of "organic" matter, it is not necessary to assume any element with a stronger "affinity" for oxygen in order to remove the latter from its association with carbon and hydrogen. All that is required is to rearrange the elements into a new set of compounds, some of which contain part of the C and H in a more fully oxidized condition.

If we start with any compound whatever of C, H, and O, which we may generalize by the formula $C_aH_bO_c$, and if c is not too large as compared with a and b, we can always write an equation to represent its decom-

position into a hydrocarbon, and usually a hydrocarbon of any type we choose, assuming the other products to be water and either CO or CO_2. In general the equation will have the form

$$mC_aH_bO_c = xH_2O + yCO(\text{or } CO_2) + zC_nH_p.$$

Thus, if we take as a starting point cellulose of the empirical formula $C_6H_{10}O_5$, and assume it to be split up into water, CO, and a paraffin (C_nH_{2n+2}) which for simplicity we may assume to be C_5H_{12}, it is a simple matter to write a series of simultaneous algebraic equations (usually indeterminate) which can be solved for *m*, *x*, *y*, and *z*. In this particular case these respective values are found to be 11, 19, 36, and 6, so that the equation must be

$$11C_6H_{10}O_5 = 19H_2O + 36CO + 6C_5H_{12}.$$

Similarly, if we assume that the particular hydrocarbon yielded is the paraffin $C_{10}H_{22}$, and that CO_2 is formed instead of CO, we can calculate that the equation must be

$$31C_6H_{10}O_5 = 23H_2O + 66CO_2 + 12C_{10}H_{22}.$$

Of course this is mere juggling with symbols, and such equations do not mean that these particular reactions actually go on, but they do prove that there is no prima-facie chemical reason why they should not go on under suitable conditions, and thus refute Mr. Hixon's reasoning.

In this connection it may be noted that Mr. Hixon wrote in a previous paper[1]: "The gases of low critical temperature which issue from volcanic vents in such quantity as to be detected are, in order of abundance, steam, CO_2, CO, hydrocarbons (from the lightest to asphaltum), H_2S, SO_2, H, N, C, and boracic acid."

Lead, S. D. W. J. S.

The Copper Market Problem

THE EDITOR:

Sir—In your issue of March 8 appears an editorial on "The Proper Way to Raise the Price of Copper," in which you advocate the partial suspension of operations of the copper mines so that the price of copper may be advanced and at the same time giving your approval to the five-day-a-week operative plan adopted by two or three copper producers, in the United States.

Very fine; but, why not go further and advocate a four-day, or a three-day or a two-day plan? Or why not go sledge length and advocate the entire suspension of the copper producers in the United States? This ought to bring about the desired result—namely, the advance in the price of copper, and you may be assured that in this *you would have the hearty support of every foreign copper producer.* But, meanwhile, what would become of the men employed in the copper mines of the United States? Must no consideration be given them? Are these men to remain idle, or to seek jobs elsewhere? Furthermore, what would become of the mines?

Here in the Copper Country of Michigan there is employed only twenty-five per cent of the number of men formerly employed in the mines, mills and smelters. Here may be seen hundreds upon hundreds of fine dwellings that cannot be sold nor rented; all idle.

Why? Just because the cheaper copper producers of South America, Africa, and elsewhere are permitted to compete on an unequal basis with the copper mines of the United States. This unequal basis is largely because of the higher standard of living enjoyed by the people of the United States as compared with those of any other nation on earth.

The copper industry is in about the same condition as that of the farmers in the Northwest. The product of the copper mines is being sold practically at what it costs to produce, or less.

The producers of copper within the United States ought to be entitled to the "home market," acknowledged to be the best in the world.

You may think that there is "a lot of loose talk about the necessity of a tariff on copper," but there are many of us who believe in "America First," and who are of the opinion that a tariff on imported copper, sufficient to equalize the respective costs of production, as between the foreign and the home producer, would give our home market to our home producers; then, use the surplus, if there be any, to compete with the foreign producer in the foreign markets of the world, as well as in our own. Then the copper mines here will "come into their own." ROBERT H. SHIELDS.

Houghton, Mich.

Our advocation of a partial curtailment on the part of copper producers was not intended to apply only to companies operating in the United States. We see no more reason why United States producers, as a geographical class, should curtail, any more than those in other countries. The suggestion was intended for all companies. With conditions as they are at present, a general curtailment of operations to less than five days a week would not supply the world's copper demand.

Conditions are bad in Michigan, we admit. But they are not entirely due to the low cost at which copper can be produced from some foreign mines. The largest amount of low-cost copper is produced right here in our own country. Would it be wise to limit by tax, the production of Utah Copper, United Verde, Miami, Nevada Consolidated, Magma, and others that can produce copper at a profit at present prices, in order to allow the high-cost Michigan mines to produce at capacity? Mining companies all over the world know that after production has continued for a long term of years, lower-grade ore usually must be mined, and the cost of getting it out of the ground is greater. There comes a time then when the mine must curtail its operations. The Michigan experience is not a new one.

To the fourth paragraph of Mr. Shields' letter we also take exception. We do not believe that the standard of living enjoyed by the people of the United States is higher than that of any other nation on earth. Conditions are no different in Canada from what they are here, and we understand that the inhabitants of many foreign countries are about as well off, live as well, and enjoy life as much as we do. Their wages are less, but their living expenses are correspondingly less. And as to bringing up this argument in regard to Chile, Cerro de Pasco, and Katanga—three of our largest foreign competitors—it does not apply, for the cost of production at those properties is considerably greater than it would be from a deposit of equal grade in the United States. The ore is merely of a sufficiently high grade, easily reduced, or present in sufficient tonnage, to make competition in the open market possible.

And in answer to Mr. Shields' last paragraph, may we ask who is going to sell the surplus at 14c. in foreign markets, to compete with the foreign producer, as long as he can get more in a protected market in this country? Something tells us that nobody would sell abroad so long as he could get more here.—EDITOR.

[1] "A Theory of Volcanic Action," *Trans.* Inst. of Mining and Metallurgy, vol. 18, p. 202; 1908-1909.

THE MINING NEWS

The Mining News of ENGINEERING AND MINING JOURNAL-PRESS is obtained exclusively from its own staff and correspondents, both in the United States and in foreign fields. If, under exceptional conditions, material emanating from other sources is published, due acknowledgment and credit will be accorded.

Summary of the Week

THE FIRST concentrate to the Magma Copper Co.'s reverberatory furnace at its new smelter at Superior, Ariz., was charged during the last week of March. The plant is designed as a model for efficient operation; the rated capacity is 3,000,000 lb. of copper per month.

The A. S. & R. Co. is shipping 1,000 tons of arsenic ore per week from the Western Utah Copper mine.

Leases have been acquired by interests connected with the Crystal Copper Co. on a number of valuable mining claims adjoining its Goldsmith property at Butte.

Deepening of the Davis shaft at Ironwood, Mich., is planned for the coming season by the Oliver Iron Mining Co.

Directors of the Compagnie du Boleo recommend the exploitation of the Triunfo mines, in Lower California.

The East Butte Copper Mining Co. is suing the Davis-Daly Copper Co. for $500,000 because of diversion of ore to the Anaconda smelter.

The Senate Gold and Silver Commission is gathering information pending advice from the Federal Trade Commission regarding the legality of an export association.

Construction of a branch connecting the South Lorrain bonanza silver district with the Timiskaming & Northern Ontario Railway has been authorized.

Establishment of a branch office at Saltillo, Mexico, by the Societe Generale des Minerais forecasts the purchase of 70,000 tons of zinc ore per year.

The Inspiration Copper company has contracted to use annually a minimum of $565,500 worth of hydroelectric power for twenty years. A new dam will be built in the Salt River valley.

A. S. & R. Co. Ships 1,000 Tons of Arsenic Ore Weekly

Output of Western Utah Copper Mine Goes to Insecticide Company—New Plant at Murray

The Western Utah Copper mine at Gold Hill, Utah, 45 miles from Wendover, under a twenty-year lease to the American Smelting & Refining Co., is producing weekly more than 1,000 tons of scorodite ores, carrying a double arsenate of calcium and iron, used in the manufacture of insecticides. This property has the largest known deposit of the kind. The ore occurs in a pear-shaped body, growing broader toward the base. Development has been done to a depth of 700 ft. only. On the 300 level, the ore is 150 ft. long by 100 ft. wide, and on the 700 level it is 290 ft. long by 60 to 70 ft. wide. The ore as broken and shipped averages 20 per cent arsenic. There is also a large percentage of iron, which makes the ore desirable for fluxing purposes. Copper, lead, zinc, and silver are also present in small quantities. The American Smelting & Refining Co. is shipping the scorodite ores to the plant of the Salt Lake Insecticide Co. at Salt Lake City, which it has under lease, and where the ores are treated according to a process devised by Dr. Frank Cameron, to produce calcium arsenate. The scorodite ores are first ground to a suitable mesh, and then leached by a caustic soda solution, which extracts the arsenic content. By the use of hydrated lime the arsenic is recovered in the form of calcium arsenate. The caustic soda is regenerated and used again. In addition to the work here outlined, the American Smelting & Refining Co. is spending $160,000 in the construction of a plant at Murray for the treatment of arsenic ores.

Purchasing Agents for Arizona Mining Companies Organize

A STATE association of mine-purchasing agents was formed at a recent meeting of all purchasing agents employed by companies operating in Arizona, which was held at Phoenix on March 20. George Jay, purchaser for the Calumet & Arizona Mining Co., presided as chairman of the meeting. E. A. Clifford, assistant general purchasing agent for the Santa Fe Ry., presented a paper on "Ethics of Purchasing." The meeting of the mine purchasing agents and the formation of their association was in conjunction with a general conference of buyers and sellers of Arizona producers, manufacturers, and distributors.

East Butte Sues Davis-Daly for Breach of Contract

Asks $500,000 In Consequence of Diversion of Ore to Anaconda—Echo of Davis-Daly Sale

The East Butte Copper Co. has started suit to recover $500,000 from the Davis-Daly Copper Co. for alleged damages for breaking the contract by which Davis-Daly copper ore was shipped to the East Butte smelter at Butte. The controversy arises out of the sale of the physical assets of the Davis-Daly company to the Anaconda Copper Mining Co. Upon acquiring the Davis-Daly mines on March 15 shipments were diverted to the Washoe Reduction Works, at Anaconda, where all of the Anaconda company's ores are treated. The East Butte company hitherto has obtained more than half of the copper on which its Pittsmont smelter has operated, from Davis-Daly ores, the contract having some time yet to run.

The company advanced the claim that it has been damaged to the extent of $500,000 by the loss of current shipments from the Davis-Daly property. Anaconda paid $3,000,000 for the Davis-Daly mines, and part of this is to be distributed as dividends to the shareholders. Davis-Daly will probably be enjoined from disbursing all of its funds pending a settlement of this new suit.

Boleo Directors Favor Participation in Triunfo Exploitation

Property in Lower California—Operating Company Formed in Mexico—Boleo has 4/15 Interest in Holding Company

Directors of the Compagnie du Boleo in a report to the shareholders declare that development work begun eighteen months ago at the Triunfo mines in Lower California has established the existence of an important deposit of ore containing arsenic, gold, and silver. An exhaustive study of processes for treating the ore has shown that profitable treatment is practicable, the arsenic as well as the precious metals being recoverable. This work has been done by an exploration and research group in which the Boleo company is interested and of which it retains the management.

The exploration group has concluded that the exploitation of the Triunfo deposit is justified and it has taken up the option which had been given to it up to Feb. 15.

In accordance with the Mexican constitutional law of 1917, the Minas del Triunfo, Aviadora del Triunfo and Peninsular companies will merge into a single company, called the Compañia Peninsular del Triunfo, with a capital of 500,000 Mexican piastres, which will remain the owner of the mining property and funds.

Capital of 25,000,000 Francs

This company, of Mexican nationality, will have its place of business in Mexico, but the bylaws will be drawn up in such a way that meetings can take place at Paris.

There will, moreover, be organized a French company, called the Compagnie Minière du Triunfo, which will control the Mexican company and will make with the latter a contract for the exploitation of the deposit, by assuming the cost of installation and the taxes. It will be organized with a capital of 25,000,000 francs, divided into 250,000 shares of 100 francs each. Of these, 200,000 shares will be subscribed in cash and 50,000 will be turned over to the members of the group in payment of their contributions. The participation of the Boleo company in the group being 4/15, it will have the right to subscribe 53,333 shares for 5,333,300 francs and it will receive its pro rata share of contribution shares.

The low prices of copper being responsible for a reduction in available resources, the directors deem that it would be imprudent under the present circumstances to take away from operating funds the necessary sum for the subscription to the total amount of the shares of the Campagnie Minière du Triunfo, to which Boleo is entitled.

The board desires to give to the holders of shares in the company, individually, the right to subscribe to the capital of the new company, the company subscribing the shares which may remain available. Certain extra subscription privileges are asked for holders of founders' shares and directors of the company. Authorization to proceed with this plan is asked of the shareholders at the next general meeting.

Agassiz Declares Advocacy of Tariff on Copper

R. L. AGASSIZ, president of Calumet & Hecla Consolidated, has wired to Houghton, Mich., to the effect that he is "strongly in favor of a protective tariff on copper." His pronouncement makes the Michigan copper district solid for the proposed duty, expressions having been received previously from the executives of the other producing companies including Calumet & Hecla Consolidated, Copper Range, Quincy, and Mohawk companies.

The Lake Superior committees now are drafting a suitable bill, and as soon as it is accepted it will be forwarded to the executives of all the copper companies in the United States for their consideration.

Old Gilpin-Eureka Mine, Unwatered, Will Be Developed

The Gilpin-Eureka mine, situated near Central City, Colo., is being unwatered. It is expected to have the mine drained to the bottom early in April. With the water disposed of, the lower levels will be cleaned out, and preparations made to at once sink the shaft to open up new ground for development. A winze will also be sunk from the lower level where the orebodies were taken out under former operations, to determine location and pitch of vein and oreshoot.

Livingstone Mine, in Idaho, To Be Opened Again

The Livingstone mine, at Mackay, Idaho, which has lain idle for twenty years, is to be reopened at once with extensive plans for exploitation. A power plant is being installed and a concentrator will be erected. A contract has been let for the installation of a 24-in. pipe line to develop power. The ore contains copper and gold, with a little silver.

Will Sink Deeper at the Moscow Mine, in Utah

Work at the Moscow mine, in Beaver County, Utah, which was resumed a short time ago under the management of Garret S. Wilkin, is meeting with encouraging results. This property in the past has been a producer of silver-lead ores, and a dividend payer. Production has been from the surface down to the 1,300 level. At present development is being done on the 1,400 level, to reach the downward extension of the orebody, and indications are favorable. Recently 2 ft. of good ore was opened, although the objective point of the drifting on this level has not yet been reached. This mine is in what is called the Star district, and so far little work has been done at depth in this section of Utah, so that the work undertaken by the Moscow is of importance to the district in general as well as to the mine itself.

Consolidated M. & S. Co. Plans to Ship Products to Europe

Surplus Zinc Concentrate and Lead Bullion Go Abroad—More Electric Power Needed—Exploration Planned

Following the completion of the first unit of the East Kootenay Power Co.'s hydro-electric plant on the Elk River, near Elko, B. C., and the consequent ample supply of power at the Sullivan mine and mill, the Consolidated Mining & Smelting Co. has been able to operate its new concentrator at capacity, for the first time since its completion. In a trial run recently 3,184 tons of ore was put through the mill in a day. At capacity rate of production, the plant is turning out far too much concentrate for the capacity of the electrolytic zinc plant and the electrolytic lead-bullion refinery at the Trail smelter.

Pending additions at the smelter and the completion of the first 20,000-hp. hydro-electric unit of additions that are being made by the West Kootenay Power & Light Co., which supplies the smelter with current, the Consolidated company has made arrangements for the treatment of the excess zinc concentrate in Belgium and the refining of the excess of lead bullion in England; and it is negotiating for the treatment of the copper matte from the Rossland Mines ores in South Wales.

Would Relieve Copper Refinery

The last arrangement, if completed, will obviate the intermittent running of the electrolytic copper refinery—there is not enough material to keep it in continuous operation—and will give the company all the available current for the production of lead and zinc, which at the present time is far more profitable than the production of copper. Furthermore, the company is endeavoring to overcome the high price of coke, which for long has been one of the chief bugaboos at the smelter, and, with that end in view, is said to be negotiating for a wharf and bunkering site either at New Westminster or Vancouver, with the idea that the ships carrying its products to Europe shall return laden with coke, for its own use and for the use of other industrial concerns in British Columbia.

Speaking before the Associated Boards of Trade for Eastern British Columbia, recently, J. J. Warren, president of the Consolidated company, said that the ore reserve at the Sullivan mine was capable of supplying the mill at capacity for the next twenty or twenty-five years, despite which, however, the company was looking for other deposits in order to have them developed by the time the present reserve is exhausted. To this end the company will maintain two survey parties in the field during the coming season for the purpose of examining likely looking prospects brought to their attention.

The company has made arrangements for the reopening of the Highland mine, near Ainsworth, under the supervision of L. W. Oughtred. This mine has been closed for two years; for some time prior to its being closed it was operated by lessees.

Eureka-Holly Replaces Plant Damaged by Fire in February

The Eureka-Holly Mining Co., at Eureka, Nev., is rebuilding its shaft house and preparing to replace the hoisting and power machinery which was damaged by fire during the latter part of February. Lumber for construction work is already on the ground and machinery has been ordered. The practically finished 100-ton concentrating plant was not damaged.

Belgian Company Wants to Expand Zinc-Ore Business in Mexico

Societe Generale des Minerais Opens Branch Office—Will Bid for Sulphide and Carbonate Ores

The Societe Generale des Minerais of Brussels, Belgium, has established a branch office at Saltillo, Mexico, for the purchase of zinc ore, similar to the offices already established in Spain, Italy, Algeria, Tunis, Sweden, Australia, and China. The company supplies ore for the zinc smelters of Belgium, and accordingly buys yearly from 600,000 to 700,000 tons of zinc ore. At present contracts in Mexico call for 30,000 tons a year, but it is expected to increase purchases to 70,000 tons a year.

The opening of an office in Mexico will do away with the middlemen, so that the Mexican zinc-ore producers may sell to the European smelters directly through their purchasing agents.

The Societe intends later to buy mines for zinc and mixed zinc and lead ores and to build concentration and calcining plants for the treatment of custom ores.

In order to reduce the very high cost of freight for the transportation of ore from Mexico to Europe, the company has decided to build a large warehouse at Tampico, equipped with up-to-date machinery to discharge the railroad cars and to load the steamers, and by the second half of the current year expects to start a monthly service between the ports of Tampico and Antwerp, Belgium. For this service two steamers of 6,000-ton capacity have been assigned.

The manager of the branch office is F. E. Salas, for twelve years general manager for the International Ore & Smelting Co., which has exported from Mexico more than 40 per cent of the zinc-ore output of the mines.

The State of Coahuila contains a number of mines carrying a good percentage of zinc which were worked extensively a number of years ago, but were forced to shut down as the freight rate to the nearest zinc smelters in the United States became prohibitive, and there was also an advance made on the import tax on zinc ores going into the United States. The rich zinc mines of Bajan suspended operations after a period of profitable operation.

Considerable zinc is also found in the Sierra Ramirez and near Parras, where properties were at one time worked successfully, but have been idle for many years. Very many of them have been abandoned and lost to former owners due to tax delinquency.

Magma Copper Smelter, at Superior, Ariz., Blown in Late in March

Plant a Model in Mechanical Design—Fuel Efficiency High—Output To Be 2,000,000 Lb. Copper Monthly—Other Activity in District Promises Customs Ore

THE new smelter of Magma Copper Co. at Superior, Ariz., was formally put into operation on March 22. For some time tests have been under way at the plant, ore has been stocked, an organization has been perfected, and everything made ready for the initial charge to the reverberatories.

The plant embodies advanced ideas of smelter design, especially in the mechanical handling of materials and the precautions taken to utilize fuel at the highest possible efficiency.

The company is fortunate in possessing in its own mine a variety of ores and flux which can be effectively combined to make an easily smelted charge. It is thus independent of tonnage from outside sources. The charge will normally average about 10 per cent copper, and the monthly production contemplated at this time from Magma ores will be about 2,000,000 lb. of copper, 50,000 oz. of silver, and $10,000 in gold. The nominal capacity is about 3,000,000 lb. of copper a month.

The beginning of operation of this smelter will mean much to the Superior district, and already there is evidence of increased mine activity. It is the intention of the company to accept custom ores from other properties.

The North Butte Mining Co., which is actively engaged in development work at a property that was formerly worked by the Calumet & Arizona Mining Co., has installed electrical equipment, power requirements having been cared for by the installation of a transmission line connecting with that from the Roosevelt dam, and exploration will be more rapidly prosecuted.

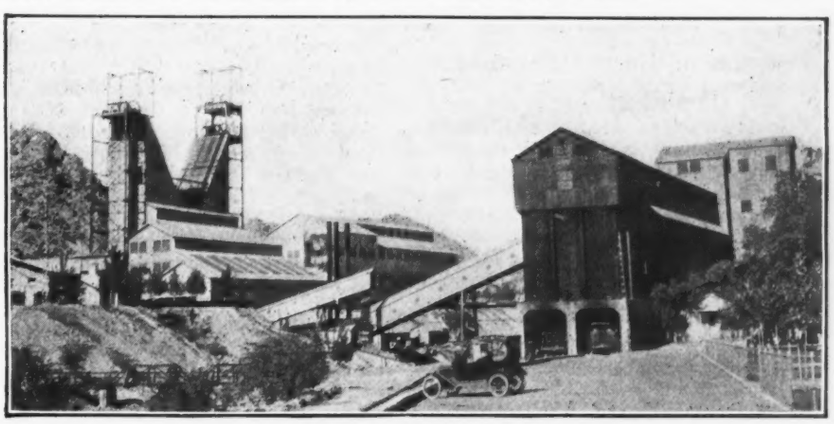
Organization of new companies for the development of groups of claims in the district that will be served by the new smelter are being announced, and it is likely that the district will experience a considerable boom. The Superior Sunnysides Mining Co. was recently incorporated for the purpose of developing a property near Superior. The Utah Arizona Mining Co. is developing a property located about ten miles west of Superior and has now completed a shaft to the 100 level.

Inspiration Will Spend at Least $565,500 for Power for Twenty Years

The Salt River Water Users' Association, of Phoenix, Ariz., has directed its manager to enter into a contract with the Inspiration Consolidated Copper Co. for power that will call for the construction of a dam at Horse Mesa, just below the Roosevelt dam, on the Salt River, costing approximately $4,200,000. The mining company has offered to guarantee a consumption of a minimum of $565,500 of power per year for a period of twenty years, with a possible consumption of $1,000,000 per year, or a sufficient sum to pay cost of construction and interest and a guaranteed profit of $1 per acre to the members of the association. The proposition will be submitted to members of the association in May, the acceptance of the proposal making necessary certain changes in the articles of incorporation. The proposed dam will be 268 ft. high, 400 ft. wide at the top, and 140 ft. wide at the bottom.

Jardine Arsenic Plant Runs

The new arsenic plant of the Jardine Mining Co. in Park County, Mont., is in full operation and seems to be successful. It will now treat about sixty tons of concentrates per day, giving close to thirty tons of arsenic. Some of the calcine rejected from this plant assays as low as 2 per cent arsenic. The company has on hand about 650 tons of arsenic-gold concentrates. According to the present program, it will ship at least two cars per week of calcined concentrates, having a value of about $3,000 per car.



Surface plant at the Inspiration mine, in the Globe-Miami district, in Arizona

Coeur d'Alene District Has Own Mine Rescue Station

Seven Companies Finance Car and Pay Safety Engineer—Rescue Training Part of Regular Work

Following the fires in the Morning and Hercules mines, which occurred a little more than a year ago, the mine operators of the Coeur d'Alene district, Idaho, took immediate steps to meet such emergencies without loss of time and in the most effective manner. A car was purchased from the United States Bureau of Mines, which was overhauled and placed in first-class condition for service. The services of Karl T. Sparks, a safety engineer for many years connected with the Bureau of Mines, were secured, and under his direction the car has been equipped with every modern device for rescue work and is kept standing on a side track at Wallace ready to be rushed to any mine in the district in case of disaster. The expense of providing and maintaining the car and the engineer in charge is borne by seven operating companies, and the training of helmet men at the several mines is under the personal direction of Mr. Sparks. He devotes one day a week to each mine.

Equipped with the Paul oxygen breathing apparatus, the men work under conditions such as would prevail in case of underground fire. Gas or smoke is turned into an underground chamber which makes normal breathing impossible, and the men go through such maneuvers as would be necessary if an actual fire prevailed, including carrying out men and going through the process of resuscitation. The men are also trained in first-aid work.

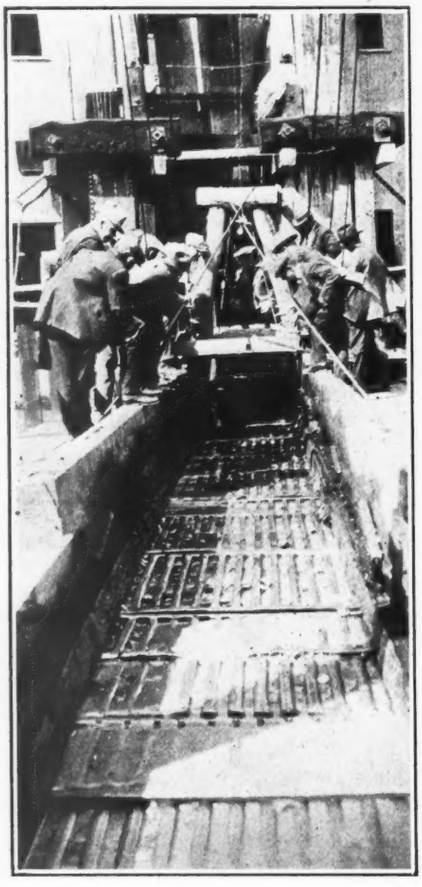
Mr. Sparks says that in the event of a mine fire he could have seventy trained helmet men on the scene in less than an hour. In his opinion the Coeur d'Alene safety station is the best in the United States, and he speaks from experience and observation in both metal and coal mines. He has personally participated in rescue work in forty-two mine fires. The Coeur d'Alene station is maintained by the Bunker Hill & Sullivan Mining & Concentrating Co., the Federal Mining & Smelting Co., the Gold Hunter Mining & Smelting Co., the Hecla Mining Co., the Hercules Mining Co., the Tamarack & Custer Consolidated Mining Co., and the Callahan Zinc-Lead Co.

Richmond-Eureka Shipments Discontinued

It is reported that the Richmond-Eureka Mining Co., which is controlled by the U. S. Smelting, Refining & Mining Co., has shipped 1,000 tons of low-grade ore from the mine at Eureka, Nev., to the U. S. smelter at Midvale, Utah, and that shipping has been discontinued for the present. This ore was mined from above the 900 level. Diamond-drill operations are being conducted from the 900 level through the Locan shaft, and a determined effort is being made to locate the faulted continuation of the large orebodies, mined in the early days, northeast of the unsolved Ruby fault.

United Trinity Mines Resumes Operations

The United Trinity Mines is reported to have started operations on the Bonanza King mine, at Carrville, Calif. The holdings of the company are said to comprise 116 claims, placer ground totaling 320 acres, and a 100-hp. hydroelectric plant on the east fork of the Trinity River. The total area held by the company is 2,800 acres. Charles T. Foster is president; E. F. Tway, vice-president, and George W. Seaman, secretary-treasurer.



Watching the sluiceway of California gold dredge

New Calumet & Helca Railroad Will Be Started Soon

Snow is rapidly disappearing in the Michigan copper district, and the early break-up means an earlier start than expected on the proposed 9-mile railroad to be built by Calumet & Hecla Consolidated between the Ahmeek and other mines on the Kearsarge lode and the Ahmeek and Osceola stamp mills on Torch Lake. The route has been surveyed. The Kearsarge lode mines are now served by the Mineral Range railroad. The new road will shorten the haul several miles and provide a gradual down-grade for loaded cars, eliminating the present up-grade from the mines to Calumet. Transportation costs will be cheaper, as the company will not have to meet the conditions prescribed by government regulations, and the shorter, easier haul will effect economies.

Three Important Transactions in Northern Ontario

Coniagas Gets Armstrong-Booth—McIntyre Now Controls Plenaurum —Refinance Kirkland Gold

Several events in northern Ontario gold districts during the last week point to increased mining activity. In Porcupine the Coniagas company has purchased a three-quarters interest in the Armstrong-Booth property for $85,000 cash, and will form a $3,000,000 company. The Armstrong-Booth property occupies a strategic position between the Goldale and the Newray, the latter being under option to the Coniagas, and if the Newray is to be a mine of any considerable size the Armstrong-Booth ground is essential. The same holds good for the Goldale, which was until recently under option to the Kerr Lake company.

Adjoining the Armstrong-Booth and the Goldale is the Plenaurum, for which the McIntyre and Goldale have been negotiating for months. Neither side, however, was able to obtain control, and the position remained in status quo until the Kerr Lake dropped its option on the Goldale. The McIntyre has now succeeded in obtaining sufficient shares to give it control by a comfortable margin, and the property will no doubt be taken over eventually by that company.

In Kirkland arrangements have been made for the refinancing of the Kirkland Gold. This property has had an unfortunate history, and the company was on the point of giving up and selling out to its neighbor, Teck-Hughes, when some new rich ore was found on the lower levels, after which the directors decided to keep on. The Teck-Hughes negotiations lapsed, and recently a new agreement was entered into with English interests, understood to be the Anglo French Co. The capital of the company is to be increased from 2,000,000 to 5,000,000 shares of $1 par, of which 1,000,000 will be preferred shares. Of the preferred shares, 500,000 will go to the Beaver company, of Cobalt, in settlement of the past-due note indebtedness, and the balance will be purchased by the new interests at 70c. a share, which will provide $450,000 of new capital. An option is also being taken on the 2,000,000 new common shares at 10c. a share. With ample money the shaft will probably be carried to 2,000 ft. and a large amount of development and exploration done. The recent high-grade discovery at 1,100 ft. is believed to be the top of a more important vein system than the company has had heretofore.

Mount Shasta Silica Co. Will Build Plant

The Mount Shasta Silica Co., of Weed, Calif., has announced that it will construct a 100-ton plant for the preparation of the material quarried from its silica deposit near Bartle. The plant will contain crushing and sizing machinery, and a commercial product of fine ground silica or diatomite will be prepared and marketed. The company was formed recently to exploit the deposits.

South Lorrain, in Ontario, Will Have Railroad

THE Provincial Government of Ontario, Canada, has appropriated $500,000 for the construction of a branch of the Timiskaming & Northern Ontario Ry. into the South Lorrain bonanza silver district. It is understood that the line will be completed and ready for operation in the fall. This construction will be of great importance not only to South Lorrain but also to the town of Cobalt. It will result in lower costs and increased activity in South Lorrain and will provide an immediate market for low-grade ores in the customs mills of Cobalt. The Keeley and Frontier properties are the principal producing companies, but prospecting is active.

Snowslides Hinder Operations in the San Juan District

The heavy fall of snow throughout the San Juan district, in Colorado, during March seriously affected production of the mines, and in many instances resulted in more or less damage to operating equipment. During the latter part of the month the slides began to run, blocking the Denver & Rio Grande R.R., which serves the district, carrying out power and telephone lines, wrecking pipe lines and tramway equipment, and frequently cutting off lines of communication between the mines and shipping points.

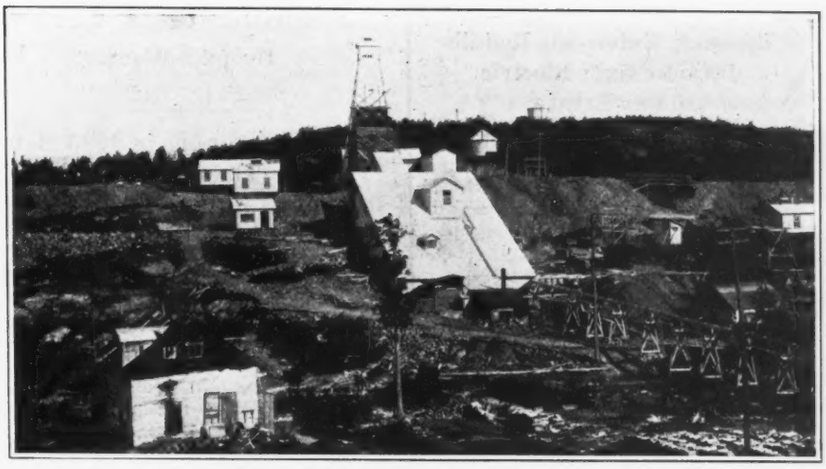
On March 20 a huge slide passed by the Blue Lake pumping station, cutting off the water supply and closing down the Smuggler Union mill, near Telluride, for fifteen hours.

A large section of the tramway equipment of the Black Bear mine was wrecked, and Harry Hill, an employee, was left suspended 300 ft. in the air on the tram cable as the snowslide took out the Cascade terminal. Hill was held a prisoner in a bucket for several hours before he could be rescued and lowered to safety.

With the constant danger of slides and the heavy snowfall common to this season in the San Juan district, mining operations will be more or less curtailed until well along in May.

Tonopah Production Cut by Shortage of Electric Power

Tonopah production during the first half of March was probably below normal, owing to power shortage and consequent necessary reduction in tonnage by most of the companies operating in this Nevada district. The Tonopah Extension has operated its 600-hp. steam plant, which practically took care of power reduction asked by the power company, so that that company's production was as usual. The Tonopah Extension shipped 111,750 oz. of bullion, valued at about $88,000, the West End 34,106 oz., valued at about $28,000, with the Tonopah Mining Co. yet to be reported. This company's bullion includes Belmont production and should be valued at about $50,000.



Mill at the Keeley mine, at South Lorrain, Ont., to which a railroad is to be built

News from Washington

By PAUL WOOTON
Special Correspondent

Gold-Silver Commission Busy Pending Advice on Export Association

Federal Trade Commission Dilatory—Statistics Lacking—Hammond Favors Export Organization—Oddie Plans Meeting After National Convention—Young Goes to Europe

THOUGH plans for a silver export association have been at a standstill for months awaiting a report by the Federal Trade Commission, there is reason to believe that some information that may be helpful will be forthcoming from that body in the near future. In the meantime the work of the Senate Commission of Gold and Silver Inquiry has been going forward steadily. The information it is compiling indicates more and more the need for collective action on the part of silver producers.

One of the important revelations of the work of the Senate commission is the fact that the silver producers have been conducting their business without adequate information. The opinion is expressed that trading in no other basic commodity is proceeding with as few facts and figures. One reason for this has been the unusual difficulties that surround the collection of such data. Silver is a world commodity. Statistics, covering silver, from certain important consuming countries do not suffice, as is the case with many other commodities. The situation is complicated by the fact that the chief consuming countries collect few statistics. In the case of silver, the statistics have to cover more than the metal itself because of the effect upon it by trade in general.

While it is known that the Federal Trade Commission has been called upon to make more investigations than its appropriation will permit, there is a feeling that the commission has not taken very seriously the request made upon it for an opinion as to a silver export association. Since the commission has to handle the matters involved in the federal government's relationship with the numerous export associations, the assumption was that a report could have been issued in a few days, which, though it may not have been exhaustive, would have been helpful. This could have been supplemented from time to time, as opportunity was found to study the situation further. The conviction is growing that it is difficult to interest the Federal Trade Commission in constructive activities and its handling of Secretary Hoover's request for suggestions in connection with the proposed silver export situation supports that conclusion.

A thought expressed in official circles is that a silver export association is well worth trying. John Hays Hammond has given the matter considerable study this winter and concurs in that belief. It is suggested that the export situation be started on as simple a scale as is possible, well within the Webb-Pomerene law as it stands, looking toward expansion as the association becomes more certain of its ground. It is believed that such an organization will be justified if it does nothing other than to supply the industry with a better statistical foundation.

Senator Oddie, the chairman of the Commission of Gold and Silver Inquiry, is of the opinion that another meeting of the silver producers should be held soon after the national political conventions. By that time it is believed that the Federal Trade Commission will have reported. In addition, it will have been determined more definitely what may be expected from the legislation providing for additional purchases of silver under the Pittman Act.

An earlier meeting has been sug-

Tonopah Extension Installs Diesel Plant; Electric Power Erratic

THE Tonopah Extension Mining Co. has ordered a 2,000 hp. Diesel engine and generator, which is to be in service early in the fall of this year. This company is mining much deeper than any other company in the Tonopah district, and has water troubles to contend with. To handle this water effectively and continually a steady and dependable supply of power must be had. The transmission line to Tonopah crosses a mountainous country and heavy winter and summer storms sometimes result in a discontinuance of power service for several days at a time. This results disastrously for a mining company which must pump water continually, and the Tonopah Extension therefore decided to install a power plant of its own.

gested, but Senator Oddie feel that this will be difficult to arrange. Neither he nor Senator Pittman could leave Washington with the session of Congress reaching its most critical stage. In addition, Senator Walsh, of Montana, is anxious to participate in this conference, but would be precluded from doing so during the progress of the oil investigation. Director Bain, of the Bureau of Mines, also advises that a much more informative report on the possibilities of the Bureau's silver research could be formulated at a later date. In like manner, the investigations of the Commission of Gold and Silver Inquiry will have been brought to a more complete stage two or three months hence.

Dr. John Parke Young, the economist in charge of the foreign currency and exchange investigation being conducted by Senator Oddie's commission, is on the point of sailing for Europe to secure certain data necessary to join phases of the work which has been done. It has been found that certain essential facts can be secured only by personal contact.

May Build Arsenic Plant Near Troy, Mont.

J. H. Ehlers and Chicago associates propose to construct a concentrator and arsenic plant of 250-ton daily capacity in the old Sylvanite camp, on the state line between Idaho and Montana, 25 miles north of Troy. The new company owns 550 lots in the townsite of Sylvanite, water rights on Fourth of July Creek, and several properties in the vicinity which have been developed to the producing stage. A sawmill will soon be in operation to furnish material for an extensive building of camp sites and the new mill. The ores of the district are reported to yield 24 per cent arsenic as well as some gold. The camp has lain neglected for more than twenty-five years. The mill complete weighs 5,000 lb. The balanced rods weigh 3,000, and the shell weighs 2,000. The heaviest part weighs 1,000 lb.

Johannesburg Letter

By John Watson

Special Correspondent

Rand Gold Mining in 1923 Better Than in 1914

Tonnage and Recovery Improve—Working Cost Up 3s.—Government Revenue Doubled

Johannesburg, Feb. 25—The following comparison of financial results, obtained by the producing mines of the Witwatersrand, for the years 1914 and 1923, has been prepared by the Gold Producers' Committee of the Transvaal Chamber of Mines:

	1914	1923
Tons milled	25,701,954	26,538,875
Gold recovered (fine ounces)	8,033,570	8,898,731
Value of gold recovered (including premium)	£34,124,434	£39,061,604
Salaries and wages paid	£11,711,982	£12,389,154
Expenditure on supplies	£9,532,360	£12,028,882
Total working expenditure	£21,943,692	£26,553,094
Total working cost per ton	17s.1d.	20s.0d.
Total working profit per ton	9s.0d.	9s.5d.
Dividends paid	£8,073,436	£8,411,970
Direct government revenue from these mines	(*a*) £1,440,223	(*b*) £2,848,024

(*a*) In respect of 1914 operations.
(*b*) Estimate in respect of 1923 operations.

The Government Areas on the Far East Rand milled during 1923, 1,777,500 tons and produced 762,511 fine ounces of gold. The total working costs bill of the company for the year was £1,556,718. The white men employed numbered 757, who earned £286,026. Native wages absorbed £337,275, and expenditure on stores and supplies amounted to £635,270. Final figures are not yet available, but the Union Government's share of profits and taxes will probably amount to over a million pounds sterling. If working costs be added, it is safe to say that this mine paid out over £2,500,000 on the 1923 operations alone. A large number of the company's shareholders are resident in South Africa, so that a goodly portion of the dividends will also be spent in this country. A provisional agreement is being entered into between the Nigel G. M. Co., Ltd., and the Sub-Nigel, Ltd., whereby, subject to a further claim area being acquired by the latter company on reasonable terms, from the government on the farm Grootfontein, the two companies will merge their respective interests. The present capital of the Sub-Nigel is £905,000. It is proposed to reduce this to £678,750 and then increase to £965,500 by the creation of 286,750 shares of £1 each. Of the newly created shares the Nigel company will receive 148,737 fully paid shares for its assets, such assets to include £25,000 cash. Under this condition the Nigel shareholders will receive two shares in the amalgamated company for every three shares now held: 100,000 shares will be offered at par to the shareholders of the amalgamated company. The remaining 38,000 shares will be held in reserve.

It is hoped that the reconstituted company will be able gradually to increase the present crushing average of 10,000 tons per month to 15,000 tons, or, possibly, 20,000 tons per month.

London Letter

By W. A. Doman

Special Correspondent

Urquhart Sees "Promising Possibilities" in Cam & Motor

Suggests Prospecting to Increase Ore Reserves—Petrol Shoot Gives Erratic Assays

London, March 12—During his stay in Rhodesia, Leslie Urquhart paid a special visit to the Cam & Motor property, accompanied by Dean P. Mitchell and P. K. Horner, and, as a result, he has addressed a letter to the chairman of the company, making certain suggestions. Apparently he looked at the position largely from the standpoint of a shareholder, as he owns "a large number." His conclusions and his recommendations, however, are indorsed by Dean P. Mitchell, P. K. Horner, and H. H. Knox, the last mentioned having been at the mine for three weeks last year.

The main suggestion is the importance of increasing the ore reserves, which Mr. Urquhart thinks can be done without interfering with profits; and as orebodies, not outcropping, may exist, he advocates a detailed geological study and a program of diamond drilling.

The price of Cam & Motor shares today is based on actual developments in the Motor shoot alone; conditions seem to favor the shoot reaching much greater depths. The Petrol shoot is in the same fissure as the Motor shoot, and, observes Mr. Urquhart, "while no positive deductions can yet be made concerning the Petrol shoot, I consider that the technical indications and developments certainly warrant optimistic expectations." Values are of an erratic character, the average of 340 ft. of ore at the fifth level, Motor mine, toward the Petrol mine, being about 35s. per ton, though assays of 172s. and 97s. have been obtained.

At the south end of No. 11 level, Motor mine, a discovery of antimonial gold ore has been driven on for 150 ft. Though Mr. Urquhart's views are largely indefinite, he is convinced that the Cam & Motor has "a large field of most promising possibilities." Metallurgical difficulties have not yet been overcome.

J. L. Teale, of Bainbridge, Seymour & Co., is back from Brazil, but only for a brief stay. The firm is devoting all its energies to the development of the South American Gold Areas (old Sao Bento property), which it is hoped will prove to be an extensive workable area, though no "fireworks" are expected.

The National Mining Corporation, which so far has not proved as successful as hoped, is largely interested in the British Equatorial Oil Co., which has sold its Venezuelan properties to the Lago Corporation. The purchase price is cash outlay, plus a large shareholding in the Lago Corporation.

The Rhodesia Exploration Co. has a long-standing grievance against the Globe & Phoenix Gold Mining Co. on account of the John Bull claims. H. G. Latilla, of the former company, has, I understand, been inspecting the Globe,

and has made certain deductions concerning the John Bull, the Globe West, and the Parallel Reef, of which more will be heard in due course.

New Guinea Copper Mines seems to be in trouble with its smelter. For many weeks notice had been given that smelting was expected to begin in November, but for various reasons it was postponed until December, the date mentioned being Dec. 26. The smelter actually started on Dec. 27, but owing to adjustments it was stopped. A fortnight later there was reference to an influenza epidemic which prevented the resumption of smelting. At the end of January the rate was 120 tons daily, and in the middle of February the smelter was treating about 200 tons of ore daily. At the end of the month, however, the smelter was stopped, principally owing to the temporary interruption of supplies of ore. A week later trouble appeared with the furnace blast, and the expected improvements in the grade of matte were not achieved. On the following day a further cable dispatch was received from Melbourne showing that there was something wrong with the steam pressure. Reading between the lines it would seem that there are deficiencies in the smelting machinery.

Oliver Mining Company Will Deepen Davis Shaft 400 Ft.

Large Steel Lined Incline Expected to Find Ore at Lower Horizon—Big Pumping Plant

It is reported authoritatively that the No. 1 shaft at the Davis mine of the Oliver Iron Mining Co. near Ironwood, Mich., is to be deepened 400 ft. Plans are being prepared and the work will be started as soon as authorization comes from the New York offices of the U. S. Steel Corporation. The shaft is already one of the deepest on the range, being over 2,600 ft. on the incline of 64 deg.; this brings the 26th or bottom level to more than 800 ft. below sea level. The largest pumping plant on the range is located on this level, consisting of three 400-g.p.m. Prescott-Menominee forged-steel pumps, pumping directly to surface. The shaft is 11 ft. 4 in. by 20 ft. outside of the "timber" and is lined with 8-in. steel "H" beams and reinforced concrete lath. It is located in the footwall slates and dips at the same angle as the formation. For the last few years little ore has been hoisted in this shaft, and the chief work done has been opening up the 24th and 26th levels to the westward and north of the Newport mine, in the hope of cutting the great orebody on which the latter has worked for many years, extracting from eight to ten million tons. This work has been disappointing, so it is proposed to continue the search at greater depth. There is a "cross" dike in this section, which apparently has interfered with the continuation of the large orebody.

Conditions on the Gogebic range are such as to make diamond drilling unsatisfactory for exploratory work, so it is being done with full-sized drifts, crosscuts, and raises, which when ore is found will be ready to handle production immediately.

Brisbane Letter

By Our Special Correspondent for Queensland, Australia

Cites Instances Supporting Magmatic Theory of Ore Deposition

Commenting on J. E. Spurr's Book—Ethridge and Mt. Coolon Districts Mentioned—Commends Work

Brisbane, Feb. 25—A writer in a Brisbane newspaper, referring to J. E. Spurr's work, "The Ore Magmas," and to the theory therein advanced that orebodies are intrusive and not deposited from solution, says that there are many cases in which the theory of intrusive magmas readily explains the nature of the ore occurrence, and cites some of these in this country. He points out that in North Queensland, at and near a place in the Ethridge field known as Percyville, many rich dabs of gold have been found at the apices of pegmatitic dikes; and that scheelite, molybdenite, bismuth, monazite, and other commercial minerals also occur, with or without gold, in these dikes. Wolfram and molybdenite-bearing quartz lodes in the Cairns hinterland, also in North Queensland, are often of a dike-like nature, as are also tin-bearing aplites and pegmatites.

The gold-bearing lode of Mount Coolon, a comparatively new gold field in Central Queensland, is, it is pointed out, another which may be a genuine intrusion. Here the gold occurs in a felsite, which seems to be a fine-grained dike offshoot from the larger masses of intrusive granite and porphyry in the district. Spurr's book is referred to as affording a great incentive to the study of the relationship between the orebodies of the mineral areas and the igneous rocks occurring in the vicinity—a study of great interest that might be pursued in Queensland with advantage to its mining industry.

The latest news from the Mount Isa silver-lead field, Cloncurry, is that last month there were about fifty miners there, most of them leaseholders, chiefly engaged in "gouging" rich ore from shallow shafts, costeans, and small open cuts. Two horse teams, two camel teams, and a five-ton motor lorry are kept busy carting ore from the field to the railway at Duchess, 64 miles distant. At that time operations were still being hampered by scarcity of water, but in the last week good rains have fallen in the district. Two companies, with liberal capital that was soon oversubscribed, have already been found to work the principal leases on the field and to treat on the spot the ore which is now conveyed many hundred miles by rail and water to the Chillagoe smelters.

Good rains that have fallen in the north have reached the Kangaroo Hills tin field, with the result that ample water has been provided for crushing purposes. Most of the established properties are now in full operation, and a good deal of attention is being given to the search for new tin lodes. One result of this search has been the opening up of a new mine called the Mountain Maid, where at the shallow depth as yet reached material of very good promise is being met. The Sardine, the principal mine on the field, is down to a depth of 340 ft., where an orebody from 2 to 3 ft. in thickness is being worked. The last two crushings from this mine have given returns of 15 and 17½ per cent of black tin respectively.

Big Increase in Ore Shipments to Trail Smelter

THE receipts of ores and concentrates at the smelter of the Consolidated M. & S. Co. at Trail, B. C., for the first two months of this year totaled 76,946 tons, which is more than 20 per cent in excess of the corresponding period of last year. Furthermore, the shipments during this year have been mainly in the form of concentrates, whereas those for the first two months of last year were mainly in the form of crude ores. It is safe to say, therefore, that the metal content received must be nearly 50 per cent greater. The Consolidated mines provided 71,512 tons toward the total, the other large shippers being: Silversmith, 1,116 tons of concentrates; Lone Pine-Surprise-Last Chance, 1,178 tons of crude ore; Quilp, 1,266 tons of crude ore; Knob Hill, 535 tons of crude ore; Paradise, 444 tons of crude ore; Rosebery-Surprise, 409 tons of concentrates; and Ruth-Hope, 138 tons of crude ore. Twenty-eight mines are shipping to the smelter.

Headframe at the Davis mine at Ironwood, Mich. The shaft is to be deepened 400 ft.

Societies, Addresses, and Reports

Committees Appointed at Silver Conference Busy

Next Meeting To Be Held at Salt Lake City—Will Be Called Within Reasonable Time

IN a communication addressed to the "silver producers of America" the American Silver Producers Association says in connection with the Pan-American Silver Conference held last year at Reno:

"The committees appointed and the officers of our temporary organization have been active and diligent since the Reno convention.

"The committee on permanent organization has perfected its report; the investigation of the facts concerning the administration of the Pittman Act has been undertaken by a former Senator, Charles S. Thomas, of Colorado, an eminent lawyer who reports favorably on the probability of being able to require the Treasury officials to purchase 14,500,000 oz. of silver which should have been purchased heretofore. Furthermore, Senator Thomas believes it more than possible that about 29,000,000 silver dollars shipped to the Orient through the Federal Reserve system under authority granted by the Pittman Act will have to be replaced in our Treasury.

"This investigation is proceeding and appropriate and necessary action will be taken to fully enforce the provisions of the Pittman Act.

"The fact-finding committee, under the chairmanship of C. F. Kelley, has done much work and has outlined a tentative plan which will be submitted for the consideration of the producers at a later day. This important committee cannot complete its report, nor will the producers be called together again until certain important questions are answered respecting the interpretation of the Webb-Pomerene Act.

"It will be remembered that this act gives authority to form and operate export associations and it is vital to the success of the contemplated silver export association that certain unsettled questions of a legal nature relating thereto be determined. Secretary Hoover, at the committee's request, has submitted these questions to the Federal Trade Commission, which, in turn, has agreed to answer them. Until these answers are received by our committee it will not be advisable to reconvene the producers in convention.

"It is of interest to know that at our suggestion, emphasized by the request of the Senate Committee of Gold and Silver Inquiry, the U. S. Bureau of Mines has undertaken research work to discover new uses for silver. Reports on this work are of an encouraging nature, and it is confidently believed that some important results will come from this investigation."

Another conference will be held soon, this time at Salt Lake City, the chairman of the association expects. At this meeting the work delegated at Reno to the several committees will be passed upon and other pertinent business will be taken up.

Illinois Geological Survey Active in 1923

Much Work in Topographic Mapping Accomplished—Oil and Coal Studies Made—Molding Sand Deposits Examined

DURING 1923, as in previous years, the investigations of the Illinois Geological Survey were directed toward the development of the state's mineral resources to insure their efficient exploration and proper conservation, according to Morris M. Leighton, chief of the Survey. These investigations followed several lines.

The increased needs for topographic maps in the various parts of the state were recognized by the last Legislature, which appropriated $50,000 per year for this work, which sum is matched dollar for dollar by the U. S. Geological Survey, making a total sum available of $100,000 per year. As a result the program of topographic mapping has been greatly stimulated, and during the field season of 1923 a total area somewhat in excess of 2,500 square miles was sketched, besides large tracts on which primary traverses were made. During the coming field season, in addition to mapping various quadrangles, a revised map of Chicago and vicinity will be made. The present maps of this area were sketched approximately twenty-five years ago and fail to meet present needs. As is true of most if not all the topographic mapping in Illinois, this project will be carried on in co-operation with the U. S. Geological Survey.

The oil pools of Illinois have been found to be closely related to certain types of rock structure. Only a part of the state has thus far been surveyed, and detailed studies were continued during the past season in three areas. One of these was in the vicinity of Allendale, Wabash County, where a new pool has been recently developed; a second in Crawford County, where it is hoped to find certain extensions of the present oil field; and a third in Greene and Jersey counties of western Illinois, which previously was unsurveyed. The results of the study of the new production in the Allendale field will probably be available at an early date. The Crawford County studies will necessarily be extended over another field season, but a report on Greene and Jersey counties is expected to come from the press some time during the next twelve months.

Studies dealing with the coal resources of the state have been made, and reports are being prepared.

A new project, the study of the molding sand resources of Illinois, was undertaken at the request of the foundry industry of Illinois. The work consisted of a detailed examination and sampling of deposits already worked and of the discovery of new deposits of possible commercial importance. Approximately 200 samples were taken, some of which were collected from deposits known by foundries to be satisfactory and which will serve as a check on the study of the untried samples.

The industrial work of the Survey is being continually supplemented by scientific work, some of which is in the form of detailed geologic studies of various quadrangles. During the past season the mapping of the geologic formations of seven quadrangles was undertaken, including the Kankakee, Oregon, Quincy, Alto Pass, Carbondale, West Frankfort and Galatia. Important stratigraphic work dealing with the differentation of the various rock formations and the construction of a correct geologic column for the different parts of the state is also being promoted.

Date Set for National Foreign Trade Convention

The National Foreign Trade Convention will be held at Boston, June 4, 5 and 6 next. This is the first time the convention has been held in New England, the birthplace of American industry. The central theme of the convention will be "Our Need for Wider Markets."

This is also the first time that a session specially devoted to the interests of importers has been included in the program. It will be held in co-operation with the National Council of American Importers and Traders.

Electrodeposition of Metals a Topic at Philadelphia Meeting

The spring meeting of the American Electrochemical Society in Philadelphia, April 24, 25 and 26, promises to be of interest to electrochemists. The headquarters will be the Bellevue-Stratford Hotel. A symposium will be held on "Recent Progress in Electrodeposition." S. Skowronski, research chemist of the Raritan Copper Co., is chairman. A series of very interesting papers have been planned for, covering "Electro-Refining of Metals," "Electro-Reduction of Metals," "Electro-Forming of Metals" and "Electro-Plating of Metals."

Fellowships in Metallurgy Jointly Arranged

The successful outcome of the coal mining fellowships arranged jointly by the Bureau of Mines and the Carnegie Institute of Technology has led to an arrangement for similar fellowships in metallurgy.

Men You Should Know About

Sidney Paige has returned to Washington after a field trip.

Glenville A. Collins, mining engineer of Vancouver, B. C., is in San Francisco.

George F. Downs and **J. E. McLurg** have been appointed directors of the British Empire Steel Corporation.

F. W. Baker, chairman of the National Mining Corporation, has returned to London from a visit to New York.

James J. Godfrey, president of the Mother Lode Mines Co. of Alaska, has been elected president of the Kay Copper Corporation.

W. E. Simpson, director of the Castle Cyanide Co. of Canada, Ltd., and representative of London interests looking for northern Ontario mining property, has sailed for England.

E. W. Hopkins, of Ironwood, Mich., manager of mines for Oglebay, Norton & Co., has returned from his winter home at New Smyrna, Florida.

Gabriel Aarons was in San Francisco recently en route to Fairbanks, Alaska, where he will inspect the properties of the Fairbanks Creek Gold Dredging Co.

R. M. Henderson, manager of the Wellington Mines Co., at Breckenridge, Colo., has returned from a six weeks' vacation in California and the Hawaiian Islands.

H. S. Montgomery, formerly with the New Cornelia Copper Co., is now in charge of the new plant of the American Grinding Co., at Vernon, Los Angeles.

Edward K. Judd has joined the staff of the Union Carbide & Carbon Co., being engaged in that company's research laboratory in Long Island City, N. Y.

Dale L. Pitt, general manager for the Premier Gold Mining Co., is in Vancouver, presumably for the general meeting of the company, which was held on April 1.

Angus Davis has just completed an examination of the Indian mine, in the Salmon River district of British Columbia, on behalf of the stockholders of the company.

C. E. Porter, convention manager of the American Mining Congress, is in Sacramento, Calif., completing arrangements for the meeting of the American Mining Congress during the fall.

John Gillie, consulting engineer; **C. L. Berrien,** general superintendent, and **R. H. Sales,** head of the geological department of the Anaconda Copper Mining Co., are in New York on business.

C. M. Weld, of Weld & Liddell, consulting engineers, has returned to New York after three weeks' absence in West Virginia, and will soon leave for Michigan to inspect a group of iron mines.

Dalziel Gordon-Smith, late of the Spassky Copper Co., Siberia, is now technical director for the Empreza Mineira do Sul de Angola, with headquarters at Mossamedes, Angola, West Africa.

A. G. Burrows, assistant provincial geologist of the Ontario Department of Mines, will supervise the field work of the department the coming season in making surveys of districts adjacent to the Timiskaming & Northern Ontario Ry.

A. W. Newberry, of New York, having completed his big game hunting expedition in Tanganyika Territory, Africa, spent a week in February visiting reduction plants in the Belgian Congo. He is now in Australia and expects to be in San Francisco early in June.

Van. H. Manning

Van. H. Manning, formerly Director of the U. S. Bureau of Mines, and who for the last few years had been Director of the Division of Research for the American Petroleum Institute, has recently resigned the latter position. Since March 10 he has been with the Pan-American Petroleum & Transport Co., his headquarters being in New York.

Sir Archibald Mitchelson, representing the British shareholders of the Porcupine Davidson Co., is in Toronto. He says there is a growing interest in financial circles in London in the gold fields of Ontario, and anticipates an increasing investment of British capital in mining properties.

Corrin Barnes, consulting engineer, and **Elmer Burt,** superintendent, of the Goldfield Deep Mines Co., have returned to Goldfield from a trip of inspection through Colorado and other western mining camps, on which they went to better judge proper pumping installation and equipment for the Goldfield Deep Mines shaft.

E. C. Saint-Smith, of the Queensland Geological Survey staff, has been appointed general manager of a company, with a capital of £450,000, lately formed in Australia by W. H. Corbould to acquire and work several of the most important leases on the big Mount Isa silver-lead field, in Cloncurry. Mr. Saint-Smith, who was graduated in mining, metallurgy and geology at the Sydney Technical College, New South Wales, has had a wide experience in mineral fields throughout Australia. Since joining the Mines Department of Queensland he has written a large number of lucid and valuable reports on the geology of different mineral fields, and on separate mines, including the Sardine, Canary, and others on the Kangaroo Hills fields. His latest were two reports on the Mount Isa field and one report on the Nightflower field, in the Chillagoe district. He has been less conservative in his reports than some other government geologists, but his predictions as to possibilities of the mines dealt with have generally been verified. The government has granted Mr. Saint-Smith a twelve months' leave of absence.

Obituary

Hume M. Frost, a prominent mining operator of Silver City, N. M., was fatally injured on March 23, when he was struck by a speeding automobile while removing a spare tire from the rear of his own machine at the side of the road near Fort Bayard. Mr. Frost came to Silver City from New York about a year ago. He was one of the organizers of the New Mexico Operating Co. and was actively in charge of this company's properties near Fierro, N. M. He was twenty-nine years old, a graduate of the University of Pennsylvania, and unmarried.

George Phillip (Sir George) Doolette, whose death occurred in London a short time ago, was an Australian gold-mining pioneer of outstanding personality. He was closely associated with the Kalgoorlie gold field, in Western Australia, in its early days, and his interests in that famous mineral region were maintained to the end. He died in his eighty-fourth year. Mr. Doolette went to Australia in 1840, when only fifteen years old, and lived in Adelaide, South Australia, for more than forty years. Following a report by some members of the South Australian branch of the Royal Geolographical Society, in 1893, on the auriferous belt at Dundas and Coolgardie, Western Australia, Mr. Doolette and a few friends formed a syndicate which sent over a party to prospect and report upon the new fields. After undergoing fearful hardships and privations and finding nothing encouraging at Coolgardie, the prospectors moved on to a new discovery known a Hannan's Find, and pegged out the leases which became the famous Ivanhoe and Great Boulder mines. A larger company was then floated, and Mr. Doolette and his friends sent the same prospectors back to the field, where they pegged a square of forty acres, which became world-known as the "Golden Mile." After forming the Lake View and the Ivanhoe companies in Melbourne and Adelaide, Mr. Doolette went to London early in 1894, at a time of great depression, to finance the Great Boulder property. He subsequently placed other properties on the London market, which soon figured among the principal dividend-paying mines of Kalgoorlie. Sir George at the time of his death was chairman of directors of the Great Boulder, Sons of Gwalia, and Bullfinch Proprietary mines.

Recent Technical Publications

Reviews, Abstracts, and References

New Bulletin on Electrical Prospecting in Sweden

An Account of Results Obtained in the Successful Search for Ore Deposits Completely Covered by Drift

Practical Experience in Electrical Prospecting. By Hans Lundberg. 37 pages, illustrated, including several map inserts. Geological Survey of Sweden, Stockholm. Price, 2 kroner.

In this pamphlet Mr. Lundberg describes the successful search for deposits of copper and iron pyrites with the system of electrical prospecting developed by himself and Harry Nathorst. He confines himself to an account of the work done in finding the Kristineberg and Bjurfors fields, in the Skelleftea district. The first was discovered in 1918 and the second in 1922 after a search of several years.

The outline of a practical method of electrical prospecting was first sketched by G. Bergstrom in 1913, according to Mr. Lundberg, and since then the method has been further developed in Sweden and in other countries. "The arrangement of *extended* electrodes (Lundberg and Nathorst system), invented in Sweden in 1918, has proved, however, to be of great importance for the success of the method," says Mr. Lundberg. "This method has been successfully applied ever since 1918 by Bergsbyran, Ltd., of Stockholm, at about sixty different ore fields in Sweden, Norway, Finland, and Spain."

The principles involved in the method are briefly outlined by the writer: By applying a potential difference between two points on the ground, an electrical field is generated in the earth. The nature of this field mainly depends on the electrical conductivity of the earth. It is best investigated by studying the distribution of the potential. It is simplest to study surfaces of equal potentials after tracing on the ground and mapping the equipotential curves which constitute the intersections (the outcrops) of these surfaces with the surface of the earth. Bodies of rocks or minerals that underlie the area thus mapped, if they are good conductors, seem to thrust these curves apart, while bad conductors seems to cause constriction.

Thus the electrical conductivity of ores is most important. Lundberg gives several tables of specific resistances of rocks, minerals, sand, and like material, wherein enormous differences are shown. These differences in conductivity are said, however, to be balanced to a certain extent by the percentage of moisture, on which the conductivity of rocks and soils depends.

The structure of the rocks affects also the potential distribution.

Lundberg thus establishes the principle that by studying the distribution of the potential in the surface of the ground, a conclusion can be formed as to the nature of the subsoil.

The arrangement of the electrodes is important. It is on the particular arrangement used that the success of the system described depends. "In conductors of great size, such as the earth, the total electrical resistance of the current circuit depends mainly on the immediate surroundings of the electrodes," says Lundberg. "It is therefore necessary to provide a large favorable contact area between the ground and the electrodes. The electrodes are therefore often given a certain horizontal extension, which has also other advantages of great practical importance."

The electrical field can be calculated in the case of homogeneous ground. The appearance of the field then depends on the arrangement and form of the electrodes. If their length is great in proportion to their distance apart, this is of advantage.

The linear (extended electrode) arrangement makes it easier to interpret the disturbances which an ore causes in the field and gives a greater chance of systematically investigating an area.

Equipment Used Simple

To supply the current needed a generator giving a single-phase alternating current of constant frequency is used. The electrodes are two metal wires 100 to 1,000 meters long or more. The further apart they are spaced, the deeper the investigation possible. Insulated wires generally connect the poles of the generator with the electrodes.

In tracing the equipotential curves a movable "searching circuit" is used. This consists of two metal rods ("searching rods") fitted with insulated handles and connected to an insulated line attached to a telephone. If direct observations of potential are wanted, another movable circuit is used, comprising a resistance bridge consisting of three rods connected to each other and to a telephone across a variable ohmic resistance. If the telephone is not sensitive enough, an amplifier can be used. For mapping curves in the field a tachymeter is used.

When the electrodes have been placed in contact with the ground and connected with the generator, the equipotential curves are traced thus: A searching rod is placed at a point *A* and the other rod at *B*, *C*, *D*, and so on successively. Assume that at *B* and *D* a sound is heard in the telephone, but no sound at *C;* then *A* and *C* are at the same potential. Other points of the same potential are found, and when they are mapped and connected with each other an equipotential curve is obtained. In the same way other curves are plotted.

Direct potential observations are made with the help of the resistance bridge. The two searching rods are put in contact with the ground at two points outside the area where potential observations are to be made, and the third rod connected to the telephone is moved between the observation points. By noticing how the sound vanishes in the telephone, points at the same potential are located by the third searching rod with the aid of the variable resistance.

After a reconnaissance has shown a certain area to have a higher conductivity, new curves may be traced in suspected places between those already drawn, so that a clearer idea as to the conducting body's form and position may be obtained. In the most disturbed areas the variation of the potential is studied more closely by detailed potential observations.

Interpretation of Results

When the equipotential curves and the direct potential observations have been mapped, they must be interpreted. Only the approximate extent and strength of the disturbances can be indicated.

The potential drop E varies directly as the current density I and the specific resistance R of the ground, in accordance with Ohm's law $E = IR$.

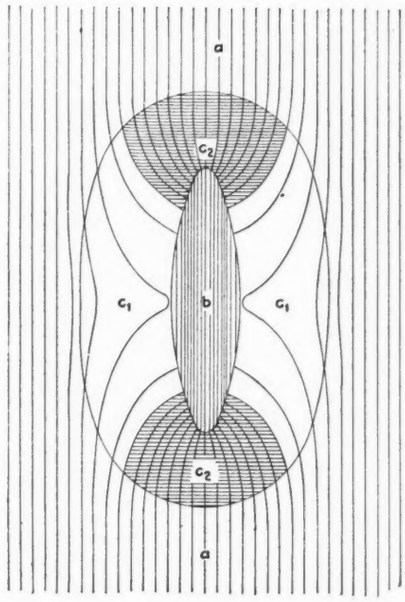


Fig. 1. *Current curves. a, Neutral ground; b, the ore; c_1, disturbed areas, with diminished density; c_2, disturbed areas, with concentrated density*

Lundberg then proceeds to show that in an electric field around a conductor or an orebody there is a neutral area, *a*, where the potential drop is fairly great, the fall in potential here being taken as standard; the area of the conducting ore, *b*, where the fall in potential is insignificant compared with the standard; and two disturbed areas, c_1 and c_2, around the ore. These are shown in Fig. 1. In c_1 the fall in potential is weaker than the standard, and in c_2 it is greater than the standard. These relationships may be determined by the reader for himself by a consideration of Ohm's law.

The map, once made, may be interpreted thus, according to Lundberg: The distance between adjoining equipotential curves is measured and its variation is expressed as a function of the distance between the same curves on neutral ground. The values of anomalies in the normal distribution

of the potential are thus obtained. Isoanomaly curves are obtained if points of equal values are connected. Above the conductor is obtained a distinct minimum whose limits coincide, within a few meters, with those of the conductor. Just beyond the conductor and especially toward the ends, more or less distinct maxima are obtained. The limits of the indication then become more strongly marked. The maxima correspond to the deformation of the equipotential curves far beyond the ends of the ore.

Boundaries of ores can, moreover, be fixed roughly by drawing profiles of the potential, either on the ground or with the map's aid.

Indications and Ore Occurrences Must Agree

Lundberg rather naïvely states that the most important factor in judging the value of the electrical method is the agreement between the indications and the existing ores. He presents figures giving the results of work done on about sixty ore deposits over a five-year period. According to these figures, strong indications correspond in most cases with ore and weak indications with impregnations. There are exceptions, of course, and some strong indications correspond with impregnations which are too poor to classify as ore. Impregnations of graphite, pyrites, magnetite or specular iron, too poor to be classified as ore, often have good conductivity and present the greatest difficulties in electrical prospecting. No *general method* of getting around this difficulty has been devised. He adds, however, that most indications of impregnations can be distinguished from ore indications.

Potential investigations give a good idea of the shape of the conductor, so if the geology of the ore field is known, the form and extent of the indication usually will decide whether the latter corresponds to an orebody, an impregnation, or a graphite schist. An electrical investigation should therefore always be conducted in conjunction with a geological survey.

"The degree of moisture in the soil," says Lundberg, "has little disturbing effect, and indications are never caused by water. Metal objects, such as pipes, naturally cause perturbations in the electrical field. Electric power cables above ground, on the other hand, do not interfere, as their frequency is totally different."

The depth of the covering soil is of importance. It is often possible to determine the depth of the cover by the strength of the indication. But the decrease is so slight that with the average depth of soil an orebody never fails to cause indications. In the cases investigated the soil has been as deep as forty meters without any considerable decrease being noticed in the indication.

How the Deposits Were Found

Having described the principles on which his method depends, the equipment used and the way it is handled, as well as the method of interpreting the results, Lundberg proceeds to describe in detail the investigations made in the Kristineberg and Bjurfors fields.

In the Kristineberg field ore boulders had been known to exist since the 80's. Efforts to find the mother lode were begun in 1917, without success. Electrical prospecting was employed in October, 1918, and in 1919 drift was removed at different spots where the indications had been strong, laying bare the ore in six places. The covering varied from one to six meters in depth. In one month an ore area of about 7,000 square meters was thus localized.

The ores occur in schists in steeply dipping lenses of coarse-grained pyrite without pyrrhotite and with more or less chalcopyrite. The average content is 32½ per cent sulphur and 2½ per cent copper. The lenses are about six to seven meters wide in most cases.

In making the electrical survey the electrodes were 160 to 200 meters apart. Five to eight curves only were traced, and the entire survey was practically only a reconnaissance. The electrical map made agrees nicely with the geological map.

It required a much greater effort to find the ore in the Bjurfors field. The first boulders of ore were found in 1903. Claims were taken several times without success. Electrical prospecting of a small area was begun in 1917, without result. In 1920 a geological survey of the district was undertaken, and that October an electrical survey was started of a large sandy plain that was the largest area ever prospected electrically. The work was continued in 1921, with negative results. "The possibility remained that the ore might be in the very rapids of Malan." The rapids were investigated in December, 1921, when they were frozen, and immediately a "broad weak zone" was discovered north of the river bank. The work was continued that spring. Other weak indications were found. The electrical survey was transferred to Bjurliden, where strong indications were observed. A test shaft struck ore within ten meters. The work in the meantime being continued in other sections, three strong indications were discovered on the sandy plain previously referred to. A diamond-drill hole put down on one of these found ore at nine meters, first poor sulphur pyrites, then a rich copper pyrites at 14½ meters.

"Thus," says Lundberg, "nineteen years after the discovery of the first boulders and after three years of systematic investigations, the ore in the Bjurfors field was struck, thanks to electrical prospecting, in the middle of a sandy plain beneath about ten meters of drift and two kilometers from the nearest ore boulder."

A detailed geological map of this area was impossible, owing to the depth of the covering. Numerous outcrops in the east and the west of the field showed leptite with layers of amphibolite.

Lundberg describes in some detail the manner of making the electrical survey and the results obtained. He uses numerous potential profiles and bore hole sections to illustrate, with frequent reference to the insert maps in the back of the pamphlet.

In the reconnaissance during the early years, the area surveyed electrically was divided in small squares of two and one-half to twenty acres. Five to ten curves were traced in every square, at least in those shown on the map. From ten to twelve acres were surveyed daily, the staff consisting of one observer and one surveying assistant. Later larger squares of 200 to 300 acres were used with reconnaissance curves 100 to 150 meters apart, as compared with twenty to thirty meters apart in the small squares. Even with such an interval between curves the weakest indication could be recorded.

How long such work takes is indicated by the statement that a staff of two observers and two surveying assistants reconnoitered from 75 to 247 acres per day; in tracing equipotential curves about 1,000 points per day were obtained by each observer. Detailed investigations were restricted to comparatively small areas because the limits of the ore zones were often definitely determined during the reconnaissance.

All electrical investigations were concluded at every place before exploration and boring were started.

Results Compared with Facts

Lundberg then proceeds to compare the indications obtained with the real facts as otherwise determined. The eastern Bjurfors indication referred to an orebody that had been examined by means of four diamond-drill holes through seven to ten meters of drift. It was a uniform lens, about 200 meters long and ten meters broad, dipping south steeply. A broad band of metamorphosed amphibolite formed the footwall, which also included rich impregnations and a body of copper ore several meters broad running about 20 per cent S and 1.3 per cent Cu, so that the amphibolite ought to make a fairly good conductor. The hanging wall consisted of a leptite metamorphosed at the contact into a sericite-quartzite, with impregnations of pyrite that ceased a few meters from the ore.

In the reconnaissance, this indication was at once announced very distinctly by the strong deflection of the curves toward the western electrode and by an increasing deformation of the curves as close as 200 meters outside the indication proper. The length of the perturbation area was almost 500 meters. A detailed inspection immediately proved that there was a very strong indication, which had a sharp boundary toward the south; toward the north. the intensity diminished at a much lower rate.

The foregoing serves to show how the indications checked with the actual ore occurrence in one case in the Bjurfors field. Similar comparisons are made by Lundberg for the other indications.

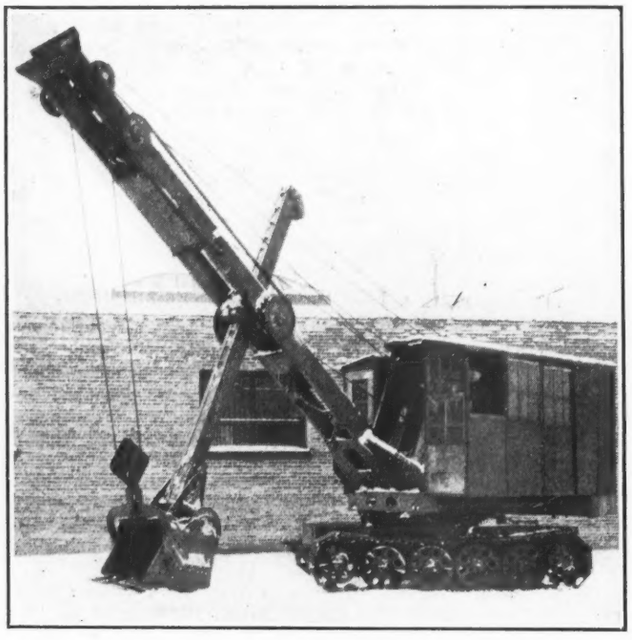
The pamphlet, though published in Stockholm, is written in English. It is remarkable for its clarity of expression, for a subject that may seem difficult to some is discussed with a lucidness that makes the paper easily readable. It is a valuable contribution to the literature of electrical prospecting. The foreword by Axel Gavelin, director of the Geological Survey of Sweden, is an appropriate introduction. Much work in electrical prospecting has been done in Sweden, he says, and the author, Lundberg, has had a greater opportunity than any other person in that country of acquiring experience in this sphere.

A. H. Hubbell.

New Machinery and Inventions

Converts Crawler Crane into Shovel

A shovel attachment for use in connection with the company's gasoline crawler crane has recently been developed by the Link-Belt Co., of Chicago. It is interchangeable and gives the crane a greater field of usefulness.



Crawler crane converted into a shovel by special boom and dipper attachment

The interchangeability of the booms makes the machine either a gasoline crawler shovel with crane boom attachment or a gasoline crawler crane with a shovel attachment.

The dipper has ¾ yd. capacity and is made entirely of manganese steel. It has been modeled after the Mesaba type. The standard dipper stick is 15 ft. long. The boom is 24 ft. center to center. All crowding motion is accomplished by a rack and pinion actuated by a combination of the hoist and hold rope used on the ordinary clamshell bucket hoist. The full power of the 60-hp. gasoline engine can be used in the crowding motion.

An Improvement in Metal Cutting Torches

A development in oxy-acetylene cutting apparatus has been announced by the Alexander Milburn Co., of Baltimore, Md. A new tip for cutting has been devised which has certain improvements over the standard tip. These consist chiefly in a better method of mixing the gases and preheating the cutting oxygen as well as giving added velocity and penetration to the preheating and cutting jets. The seat of the tip can be easily renewed at a fraction of the cost of a complete tip, rendering it unnecessary to re-machine or discard the used tips. This renewable seat facilitates the cleaning and maintenance of the tip.

Ingenious Device Employed in Cutting 27-in. Shaft

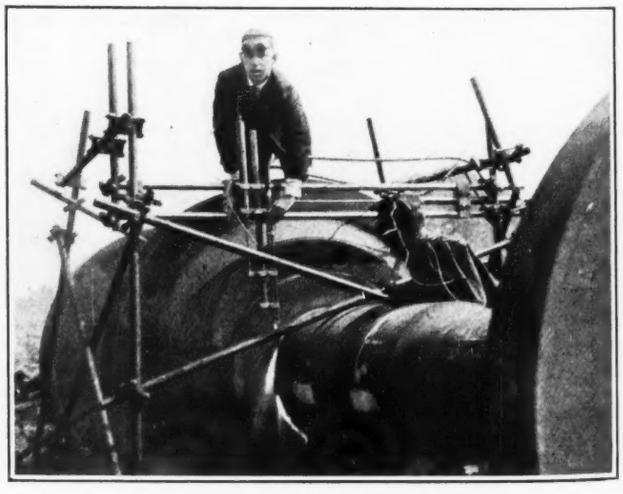
Several clean, straight cuts through a solid steel generator shaft, weighing 40,000 lb. and 27 in. in diameter, were recently made in from ten to seventeen minutes, with a gas consumption of 600 cu.ft. of hydrogen and 2,000 cu.ft. of oxygen per hour, operating on 75 lb. oxygen pressure and 60 lb. hydrogen pressure. This work was done by the Purox Company with a "New Style 'F'" cutting torch, equipped with a straight head and a Purox No. 4 hydrogen tip.

The rate of cutting was from 1½ to 2 in. per minute and cuts were completed in from ten to seventeen minutes. Twelve and one-half feet each of ⅜-in. oxygen and hydrogen hose were used. Eight cylinders of oxygen were connected to a manifold on the high pressure side and the oxygen was delivered to the torch through four regulators, manifolded together. Eight cylinders of hydrogen were also connected to a manifold, and the gas was delivered to the torch through a single regulator.

Owing to the intense heat produced in such heavy cutting, and the consequent punishment to the operator in attempting to manipulate a torch continuously for the length of time required to complete a cut, an extremely ingenious device was rigged up to carry the torch at the required uniform speed up and over the shaft as the cut progressed. The device consisted of a pipe framework erected over the horizontal shaft and supporting two 1½ in. parallel steel rails laid 6 in. apart horizontally across the shaft and 3 ft. above it. The oxy-hydrogen torch was fastened to a carriage traveling on these rails and propelled by hydraulic pressure from a tee into the oxygen line. The water piston was arranged to pull in either direction, its speed being controlled by a needle valve.

Simultaneous vertical motion was also provided for by a device clamped to the torch and carriage, a second water piston controlling the speed; so that the torch traveled around the shaft, cutting the steel, with the tip held constantly at a distance of about half an inch from the surface.

Altogether, five cuts were made with very narrow kerfs and extremely smooth surfaces. The address of the Purox Company is 828 17th St., Denver, Colorado.



Rigging used to carry torch at uniform speed up and over shaft. No power was available where the work was done

TRADE CATALOGS

Pipe Machine. Williams Tool Corporation, Erie, Pa., has issued a 32-page illustrated catalog describing its "Willie Williams" portable power pipe-threading machine.

Mechanical Shovels. The Hoar Shovel Co., Duluth, Minn., has issued a new 24-page bulletin describing the Hoar shovel in text and illustrations.

Prospecting Drills. The Keystone Driller Co., of Beaver Falls, Pa., has issued a 196-page book entitled "Drilling for Placer Gold." It is divided into three parts. Part 1 consists of four chapters, by Walter H. Gardner, on the subjects: Advantages of the Keystone Drill; Proper Drilling Methods; Laying Out the Ground and Estimating the Values; Reliability of Keystone Samplings. Part 2, "Authoritative Articles on Mineral Prospecting," consists of reprints from the company's Catalog No. 2, 1917 edition, and from various technical journals. Part 3, "Mineral Prospecting Machinery," consists of six chapters, three of them by R. M. Downie, one by E. E. Free, and one by C. S. Haley. The book is well illustrated and of a handy size. Any one interested will find it of value.

Heating Units. Aerofin Corporation, 750 Frelinghuysen Avenue, Newark, N. J., has issued a 26-page catalog describing Aerofin tubes for heating or cooling air.

THE MARKET REPORT

Daily Prices of Metals

Mar.	Copper, N. Y. net refinery*	Tin		Lead		Zinc
	Electrolytic	99 Per Cent	Straits	N. Y.	St. L.	St. L.
27	13.125@13.25	51.00	51.50	9.00	8.70	6.30@6.35
28	13.125@13.25	50.75	51.25	9.00	8.65	6.30
29	13.125@13.25	49.50	50.00	9.00	8.65	6.25@6.30
31	13.25 @13.375	48.75	49.25	9.00	8.65	6.25
Apr. 1	13.25 @13.375	49.75	50.25	8.975	8.625	6.125@6.20
2	13.25 @13.375	58.75	51.375	8.975	8.625	6⅛@6.175
Av.	13.250	50.104	50.604	8.992	8.650	6.244

*These prices correspond to the following quotations for copper delivered: March 27th to 29th, inc., 13.375@13.50c.; March 31st to April 2d, inc., 13.50@13.625c.

The above quotations are our appraisal of the average of the major markets based generally on sales as made and reported by producers and agencies, and represent to the best of our judgment the prevailing values of the metals for deliveries constituting the major markets, reduced to the basis of New York cash, except where St. Louis is the normal basing point, or as otherwise noted. All prices are in cents per pound. Copper is commonly sold "delivered," which means that the seller pays the freight from the refinery to the buyer's destination.

Quotations for copper are for ordinary forms of wire bars, ingot bars and cakes. For ingots an extra of 0.05c. per lb. is charged and there are other extras for other shapes. Cathodes are sold at a discount of 0.125c. per lb.

Quotations for zinc are for ordinary Prime Western brands. Quotations for lead reflect prices obtained for common lead, and do not include grades on which a premium is asked.

The quotations are arrived at by a committee consisting of the market editors of *Engineering and Mining Journal-Press* and a special representative of the Bureau of Mines and the Bureau of Foreign and Domestic Commerce.

London

Mar.	Copper			Tin		Lead		Zinc	
	Standard		Electrolytic						
	Spot	3M		Spot	3M	Spot	3M	Spot	3M
27	64⅛	65⅛	70	256	255¼	35¼	34½	34¼	33¾
28	64¼	65⅛	70⅛	261¾	260¾	35½	34¾	33⅞	33¾
31	64¼	65⅛	70¼	254	253	35¼	34½	33½	33⅜
Apr. 1	65	65⅞	70¾	257½	256½	34⅜	33¼	33⅛	32¾
2	65⅜	66¼	71½	261½	260¼	34⅜	33⅜	33⅝	34

The above table gives the closing quotations on the London Metal Exchange. All prices in pounds sterling per ton of 2,240 lb.

Silver, Gold, and Sterling Exchange

Mar.	Sterling Exchange "Checks"	Silver		Gold London	Mar.	Sterling Exchange "Checks"	Silver		Gold London
		New York	London				New York	London	
27	4.29½	64⅛	33½	96s 1d	31	4.29⅝	63¾	33 5/16	96s ..
28	4.29½	63⅞	33⅜	95s 11d	Apr. 1	4.29¾	63¾	33¼	95s 11d
29	4.29½	63¾	33 5/16	.....	2	4.30¼	63⅝	33⅛	95s 10d

New York quotations are as reported by Handy & Harman and are in cents per troy ounce of bar silver, 999 fine. London silver quotations are in pence per troy ounce of sterling silver, 925 fine. Sterling quotations represent the demand market in the forenoon. Cables command one-quarter of a cent premium.

Average Metal Prices for March

Copper:	
New York Electrolytic	13.515
London Standard	66.137
London Electrolytic	72.137
Lead:	
New York	9.013
St. Louis	8.891
London	37.161
Silver:	
New York	63.957
London	33.483
Sterling Exchange	428.769
Zinc:	
St. Louis	6.488
London	35.298
Tin:	
99 per cent	54.370
Straits	54.870
London	277.429
Quicksilver	64.269
Antimony	11.442
Platinum:	
Refined	121.692
Crude	113.231

Metal Markets

New York, April 2, 1924

Very little activity has been in evidence in the non-ferrous metal markets during the last week, one seller characterizing the situation as the dullest in years, though this seems an exaggeration. But certainly, with the recent declines in London, chiefly of a speculative nature, consumers here are in no mood to buy further ahead than necessary. Further, there have been rumors that some industries have found it desirable to cut production, and the stock market has been weaker. Fundamentally, metal consumption continues excellent, but sentiment seems somewhat mixed regarding the prospects for a good summer business.

Copper

Only a few orders of as much as 500 tons have been placed during the week, the reduced prices named by some producers having had little effect in tempting consumers. Some of the larger producers have sold little or nothing, holding their prices well above that at which business has been done. The slight gain in prices made in the last two or three days has been caused by the improvement in London, and not by any better demand here. Producers today can get 13½c. or slightly less, f.a.s., so have little incentive to sell at the same price, delivered, in the domestic market. Foreign sales for the week have been quite satisfactory, France, Germany, Italy, and Scandinavia being represented in the list of buyers. In general, there has been no difference in the prices quoted for prompt or forward deliveries.

Lead

The official contract price of the American Smelting & Refining Co. continues at 9c., New York.

Concessions from the price asked by the leading interest have been freely offered during the week, particularly in the last two days, when the market has been thoroughly canvassed for prompt lead at 8¾c. and forward lead down to 8½c., New York. Consumers show little interest, however, apparently being well supplied for April and being willing to see if the price will not fall further before laying in their requirements for later months. Many have already contracted for much of their May lead, also. Practically all of the lead that has been sold during the week has been on a contract basis at the fixed price or at our average.

The St. Louis market has also been weak, and today a forced sale probably would not command more than 8½c. Prompt chemical lead would no doubt command the highest price.

Zinc

Practically no zinc has been sold this week, some producers being entirely out of the market at current levels. High-grade continues at 8@8¼c. delivered. Prices in New York continue at the equivalent of the freight differential from St. Louis, a premium of 35c. per 100 lb.

Tin

Tin sales for the week have been almost entirely confined to dealers, consumers not being interested, even when the market dipped under 50c. Forward tin has ruled at from one-half to one cent below the prices quoted for spot.

Classification of tin imports made by the New York Metal Exchange is as follows:

	1924 March	1924 Three Months
Straits	2,710	15,170
Australian	45	225
Banka & Billiton	20	425
English	125	1,735
Chinese	85	675
Sundries	75	220
Total long tons	3,060	18,450

Silver

The market for the last week has shown an easier tendency on account of continued apathy on the part of China. The Indian bazaars are showing interest only at lower rates, and London reports sales from that quarter.

Mexican Dollars—March 27th, 48⅞; 28th, 48⅝; 29th, 48⅝; 31st, 48⅝; April 1st, 48⅝; 2d, 48½.

Foreign Exchange

On Tuesday April 1, closing cable quotations on francs were 5.79c.; lire, 4.51c.; and Canadian dollars, 2⅛ per cent discount.

Other Metals

Quotations cover large wholesale lots, f.o.b. New York, unless otherwise specified.

Aluminum—99 per cent, 28@29c. per lb.; 98 per cent, 27@28c.

London, 98 per cent, £115 per long ton.

Antimony—Per lb.:

Chinese and Japanese brands, 10⅜@11c.

W. C. C. brand, 12@13c.

Cookson's "C" grade, 14¼@14⅜c.

Chinese needle, lump, nominal, 7½@8½c.

Standard powdered needle, 200 mesh, 9@10c.

White oxide, Chinese, 99 per cent Sb_2O_3, 10@11c.

Market weaker, with larger offerings.

Bismuth—$2.35@$2.45 per lb. London, 10s.

Cadmium—70@75c. per lb. London, 2s. 6d.

Cobalt—$2.50@$3 per lb. Discounts on contracts. Oxide, $2.10@$2.25. London, 11s. for metal; 9s. for black oxide.

Iridium—$270@$275 per oz.

Magnesium—Sticks, 1⅛ in., 99.9 per cent, 90c.@$1 per lb. London quotes 3s. 3d. for 99 per cent.

[1]**Molybdenum**—99 per cent, $12 per lb.

Monel Metal—32c. per lb.

Nickel—26@30c. per lb. for 99 per cent virgin metal. London, £130@£135.

Osmium—$100@$110 per troy oz.

Osmiridium—Crude, $58.50 per oz.

Palladium—$83 per oz. Crude, $60 per oz. London, £17.

Platinum—Refined, March 27, $120; 28, 29, 31, April 1 and 2, $118.

Crude, $111@$113.

London, £28 for manufactured.

Market easier, with lighter demand from jewelers. Only a little sold.

Quicksilver—$68@$70 per 75-lb. flask. flask. San Francisco wire $69. London, £12¾@£13.

Radium—$70 per mg. radium content.

Rhodium—$100@$105 per oz.

Selenium—Black powdered, amorphous, 99.5 per cent pure, $2.10 per lb.

Tantalum—Metal, $400 per kg.

Tellurium—$2 per lb.

[1]**Thallium Metal**—Ingot, 99 per cent pure, $8 per lb.

Tungsten Metal—Powder, 97 to 98 per cent, 95c.@$1 per lb. contained tungsten.

Metallic Ores

Chrome Ore—Per ton, c.i.f. Atlantic ports:

Indian, $19.50.

Rhodesian, $21.50.

New Caledonian, $24.

Not very much activity.

Iron Ore—Lake Superior ores, per long ton, Lower Lake ports:

Old Range, bessemer, 55 per cent iron, $6.45.

Mesabi, bessemer, 55 per cent iron, $6.20.

Old Range, non-bessemer, 51½ per cent iron, $5.70.

Mesabi, non-bessemer, 51½ per cent iron, $5.55.

Magnetite Ore—F.o.b. Port Henry, N. Y., per long ton:

Old bed, 21 furnace, $5.

Old bed, concentrates, 63 per cent, $5.25.

Harmony, cobbed, 63 per cent, $5.25.

New bed, low-phosphorus, 65 per cent, $7.50.

Manganese Ore—44@46c. per long ton unit, seaport, plus duty.

Molybdenum Ore—75c. per lb. of MoS_2 for 85 per cent MoS_2 concentrates. Nominal.

Tantalum Ore—Foreign, 30@50c. per lb. of Ta_2O_5 contained, c.i.f. New York, according to quality.

Tungsten Ore—Per unit, N. Y.:

High-grade wolframite, $9@$9.25.

High-grade scheelite, $10.

Ordinary grades, $8.75@$9.

Vanadium—Minimum 50 per cent V_2O_5, $1@$1.25 per lb. Nominal.

Zinc and Lead Ore Markets

Joplin, Mo., March 29—Zinc blende, per ton, high, $44.40; basis 60 per cent zinc, premium, $42@$41; Prime Western, $40; fines and slimes, $39@$38.50; average settling price, all zinc ores, $42.90.

Lead, high, $128.35; basis 80 per cent lead, $110; average settling price, all lead ore, $124.86 per ton.

Shipments for the week: Blende, 15,028; lead, 1,150 tons. Value, all ores the week, $788,700. Shipments for three months: Blende, 192,915; calamine, 329; lead, 24,411 tons. Value all ores three months, $11,144,280.

Stocks have been decreased approximately 20,000 tons since the first of the year, leaving about 32,000 tons in the bins.

Purchases during the five weeks of March were only 3,000 tons more than those for the four weeks of February.

Platteville, Wis., March 29—Blende, basis 60 per cent zinc, $43 per ton. Lead, basis 80 per cent lead, $115 per ton. Shipments for the week: Blende, 285 tons; lead, none. Shipments for the year: Blende, 6,113; lead, 232 tons. Shipments for the week to separating plants, 242 tons blende.

Non-Metallic Minerals

Prices received for non-metallic minerals vary widely and depend upon the physical and chemical characteristics of the commodity. Hence the following quotations can only serve as a general guide as to the prices obtained by producers and dealers in different parts of the United States for their own product. In the last analysis the value of a particular non-metallic mineral can only be ascertained by direct negotiation between buyer and seller.

Asbestos:

Crude No. 1—$300@$400.

Crude No. 2—$175@$225.

Spinning fibers—$90@$150.

Magnesia and compressed sheet fibers—$60@$90.

Shingle stock—$50@$70.

Paper stock—$32.50@$40.

Cement stock—$20@$25.

Floats—$10@$12.

All per short ton, f.o.b. mines, Quebec, tax and bags included.

Market stronger in short grades. Producers talking about getting together to help market.

No. 1 Rhodesian crude, $325; No. 2, $200 per short ton, c.i.f. New York.

Barytes—Crude—$8 per ton, Missouri mines, 90@98 per cent $BaSO_4$; $8.50 per ton, f.o.b. Georgia mines; $6@$8, at Baltimore.

Ground—Off color, $13 per ton, Baltimore; white, $16, Baltimore.

Water ground and floated, $23@$25, f.o.b. St. Louis.

No change in price, but a good demand reported for crude and ground products.

Bauxite—American, f.o.b. shipping point per gross ton:

Crushed and dried, $5.50@$8.75.

Pulverized and dried, $12@$14.

Calcined, crushed, $20.

Foreign, per metric ton c.i.f.:

French, 5 per cent SiO_2, $5@$6.50.

Dalmatian, low SiO_2, $6.50@$7.50.

Other grades, $4.65@$6.

Beryl—4½c. per lb. f.o.b. Connecticut points. Nominal.

Borax—Granulated and refined, crystals or powdered, in bags, carloads, 5½c. per lb.; in bbls., 5½c. Boric acid, 10½c.

Market about normal.

Chalk—F.o.b. New York, per lb.:

English, extra light, 5c.

Domestic, light, 4¼@4½c.

Domestic, heavy, 3½@3⅝c.

In bulk, $5@$5.50 per ton.

China Clay (Kaolin)—F.o.b. Virginia mines, per short ton:

Crude No. 1, $7.

Crude No. 2, $6.

Washed, $8.50.

Powdered, $13@$20.

Powdered (Blue Ridge), $14@$20.

Imported English, f.o.b. American ports:

Lump, $15@$20.

Powdered, $45@$50.

[1]Price furnished by Foote Mineral Co., Philadelphia.

1A grade, domestic, $16.50@$18, f.o.b. mines.

Diatomaceous Earth—Per ton, f.o.b plant, California:
Kiln-fired brick, $65.
Kiln-fired aggregate, $45.
Insulating powder, $30.
Natural aggregate, $20.

Emery—Per lb., f.o.b. plant:
Greek Naxos, 6½c.
Turkish, 6½c.
Khasia, 5½c.
American, 4c.

Feldspar—Per long ton, f.o.b. cars, North Carolina:
No. 1 pottery grade, $6.50@$7.50, depending upon quality.
Owing to weather conditions and shortage of crude material some grinding mills are paying a bonus for prompt shipment.
No. 2 pottery grade, $4.50@$5, depending upon quality.
No. 1 soap grade, $7.
Ground, 90 to 100 mesh, $10 per short ton.
In Connecticut, per net ton, f.o.b. mines:
60 to 80 mesh, $20.
150 mesh, $25.
200 mesh, $30.
Good demand.
In New Hampshire, per net ton, f.o.b. mines:
Pottery grade, $7.
No. 1, not exceeding 10 per cent SiO_2, $8.
Ground, $17@$20, f.o.b. mill.
Demand has eased slightly, but indications point to a good future.
In New York, per ton, f.o.b. cars:
No. 1, $8.
Demand good.
In Maine:
No. 1 ground, $19.
Market better than for a long time.
In Tennessee:
No. 1 ground, $15.32@$21 per ton, f.o.b. mill.
Inferior grades, ground, $10 per ton.
Crude, $6.50 for ordinary grades. As high as $7.50 offered for exceptional quality.
In Canada:
No. 1 crude, $7 per short ton.
No 1 ground, 150 mesh, $20.

Fluorspar—F.o.b. western mines, per net ton:
Not less than 80 per cent CaF_2 and not over 5 per cent SiO_2, $22.
Not less than 85 per cent CaF_2 and not over 5 per cent SiO_2, $23.
Ground, 93 to 97 per cent CaF_2 and not over 3 per cent SiO_2, $35 in bulk, $39 in bags or barrels.
Acid ground, not less than 98½ per cent CaF_2 and not over 1 per cent SiO_2, $45 in bulk, $49 in packages.

Fuller's Earth—Per ton, f.o.b. Midway, Fla.:
16 to 30 mesh, $16.50.
16 to 60 mesh, $18.
30 to 60 mesh, $18.
60 to 100 mesh, $14.
Plus 100 mesh, $7.50.

Garnet—Per short ton:
Spanish grades, $60, c.i.f. port of entry.
Domestic Adirondack, $85, f.o.b. shipping point.
Canadian, $70@$80, f.o.b. mines.

Gilsonite—Per ton, f.o.b. Colo.:
Jet asphaltum, $36.
Selects, $32.
Seconds (ordinary grades), $25.50.

Graphite—First quality, per lb.:
Ceylon lump, 5½@6c.
Ceylon chip, 4¾@5c.
Ceylon dust, 3½@4c.
Crude amorphous, $15@$35 per ton.
Flake, finely ground, 3@50c.
Lubricating quality, 7@30c.
Foundry quality, 3@8c.
Graphite in large quantities is ordinarily used for manufacturing crucibles, but such demand has not been as large as usual lately. Prices are low.

Gypsum—Per ton, depending upon source:
Crushed rock, $3@$4.50.
Ground, $3.50@$6.
Agricultural, $5@$7.
Calcined, $8@$16.

Ilmenite—Concentrates, 52 per cent TiO_2, 1½c. per lb., f.o.b. Virginia points. $20 per short ton, Florida mines.

Kaolin—See China Clay.

Limestone—Depending upon source, f.o.b. shipping points; per ton:
Crushed, ½ in. and less, $1.10@$1.70.
Crushed, 3 in. and larger, 90c.@$1.50.
Agricultural, $1.50@$5.

Magnesite—Per ton, f.o.b. California mines:
Calcined lump, 85 per cent MgO, $35.
Calcined ground, 200 mesh, $45.
Dead burned, $32@$34, Washington.
Dead burned, $40@$42, Chester, Pa.
Caustic calcined, Grecian, $50@$51, c.i.f., New York.
Market good.

Manjak—Barbados, in 1 to 5 ton lots:
Grade "A," 8@11c. per lb.
Grade "AA," 9½@12½c. per lb.
Grade "C," fine, 10½@13½c. per lb.
Grade "C," fine and lump, 12@15c.
Grade "C," lump, 13½@16½c.

Mica—
North Carolina prices:
Scrap, $17@$20 per ton.
Sheet, per lb., No. 1 quality, clear:
Punch, 1¼ in., 6c.

1½ x 2 in., 15c.	3 x 4 in., $1.75.
2 x 2 in., 30c.	3 x 5 in., $2.
2 x 3 in., 70c.	4 x 6 in., $3.
3 x 3 in., $1.25.	6 x 8 in., $4.50.

Ground, 60 mesh, $65 per ton.
Ground, 80 mesh, $70.
Ground, 120 mesh, $120.
Ground, 140 mesh, $125.
In New Hampshire:
Washer and disk, $280 per ton.
Scrap, $24 per ton.

[1]**Monazite**—Minimum 6 per cent ThO_2, 6@8c. per lb.

Ocher—"Yellow Peruvian," $22.50@$30 per ton, Georgia mines.

Phosphate — Per long ton, f.o.b., Florida:
76@77 per cent, pebble, $6.
75 per cent, $5.50.
74@75 per cent, $5.25.
70 per cent, $3.80.
68 per cent, $3.50.

[1]Price furnished by Foote Mineral Co., Philadelphia.

In Tennessee hand-mined lump, $7@$7.25 per long ton for 75 per cent with adjustment of 25c. per unit for variations. Washed rock, $6.50 for 65 per cent per short ton with adjustment of 15c. per unit for variations.
Washed run of mine, 72 per cent, $5.50 per short ton.

Potash—Contract prices, per ton:
Kainit, 14@16 per cent, $7.33.

Pumice Stone—Imported lump, 3@40c. per lb.
Powdered, in bbl., 3@5c.
Lumps, in bbl., 6@8c.

Pyrites—Tharsis, per long ton unit, c.i.f. U. S. ports:
Furnace size, 12c.
Lump, 12c.
Fines, through ½ in., 12c.
Cinder from ore to remain property of buyers.
Market improving.

Silica—Water ground and floated, per ton, f.o.b. Illinois:
450 mesh, $31.
350 mesh, $25.
200 mesh, $20.
100 mesh, $8.
Market for amorphous silica is good.
Glass sand, $2@$2.50 per ton; brick and molding sand, $2@$2.25.

Rutile—F.o.b. Virginia points, per lb.:
Granular, 94@96 per cent TiO_2, 12@15c.
Pulverized, 100 mesh, 94@96 per cent, 17@30c.
93 per cent TiO_2, 10@12c., Florida.

Sulphur—$16@$18 per ton for domestic, f.o.b. Texas and Louisiana mines; 18@20 for export, f.a.s. New York.

Talc—Per ton, in 50 lb. paper bags, Vermont mills, carloads:
Ground, 200 mesh, extra white, $10.
Ground, 180 mesh, medium white, $9.50.
Ground, 160 mesh, medium white, $9.
In New York, double air-floated, including containers:
200 mesh, $13.75.
325 mesh, $14.75.
Demand good.
In California $20@$30 per ton, ground.
In Georgia, powdered, per ton:
White, $12.
Grayish white, $8@$10.
Red, $12@$14.
Yellow, $8.
Roofing, $7.50@$8.

Tripoli—Per short ton, burlap bags, paper liners, per minimum carload 30 tons, f.o.b. Missouri:
Once ground:
Rose and cream colored, $16@$25.
White, $18@$27.
Double ground:
Rose and cream, $17@$25.
White, $19@$30.
Air-float:
Rose and cream, $25@$30.
White, $35.
Super air-float:
Rose and cream, $35@$40.
White, $40@$45.

Zircon—Freight allowed east of Mississippi River:
99 per cent, 6c. per lb., f.o.b. Florida.
Powdered, 7c. per lb., f.o.b. Florida.

Mineral Products

Arsenious Oxide (white arsenic)—11½c. per lb.

Copper Sulphate—4.90@5c. per lb., car lots.

Sodium Nitrate—$2.50 per 100 lb., ex vessel Atlantic ports.

Potassium Sulphate—Basis 90 per cent, $41.50 per ton.

Sodium Sulphate—$24@$26 per ton, New York.

Zinc Oxide—Per lb. in bags:
Lead free, 7¾c.
5 per cent lead sulphate, 7½c.
10 to 35 per cent lead sulphate, 7c.
French, red seal, 9¾c.
French, green seal, 10¾c.
French, white seal, 12c.

Ferro-Alloys

[1]**Ferrocerium**—$7 per lb.

Ferrochrome—1 to 2 per cent carbon, 30c. per lb.; 4 to 6 per cent carbon, 11½c. per lb.

Ferromanganese — Domestic, 78@82 per cent, $107.50 per gross ton, f.o.b. furnace. Spiegeleisen, 19@21 per cent, $38@$39, f.o.b. furnace; 16@19 per cent, $37@$38.

Ferromolybdenum—$2 per lb. of contained molybdenum for 50 to 55 per cent grades.

Ferrosilicon—10 to 12 per cent, $41.50 @$46.50 per gross ton, f.o.b. works; 50 per cent, $75 delivered.

Ferrotitanium—For 15 to 18 per cent material, $200 per ton, f.o.b. Niagara Falls, N. Y.

Ferrotungsten — 91@93c. per lb. of contained W, f.o.b. works. Quiet.

[1]**Ferro-uranium**—35 to 40 per cent U, $4.50 per lb. of U contained, f.o.b. works.

Ferrovanadium — $3.50@$4 per lb. of V contained, f.o.b. works. Active.

Metal Products

Rolled Copper—Sheets, 21¼c.; wire, 16c.

Lead Sheets—Full lead sheets, 12.75c. per lb.; cut lead sheets, 12.50c. in quantity, mill lots.

Nickel Silver—27¼c. per lb. for 18 per cent nickel Grade A sheets.

Yellow Metal — Dimension sheets, 18¾c. per lb.; rods, 15¾c. per lb.

Zinc Sheets—9¾c. per lb., f.o.b. works.

Refractories

Bauxite Brick—$140@$145 per M., Pittsburgh, Pa.

Chrome Brick—$45@$47 per net ton, f.o.b. shipping point.

Firebrick—First quality, $42@$45 per M., Ohio and Kentucky works; $42@$45 Central Pennsylvania; second quality, $35@$38.

Magnesite Brick — 9-in. straights, $65@$68 per net ton, f.o.b. works.

Magnesite Cement—$47@$50 per net ton, f.o.b. Chester, Pa.

Silica Brick—$42@$45 per M. Pennsylvania; $50@$53 Alabama.

Zirkite—Powdered, 80 per cent ZrO_2, 5c. per lb.; 70 per cent, 2½c. per lb. Brick, straights, 75@95c. each.

[1]Price furnished by Foote Mineral Co., Philadelphia.

The Iron Trade

Pittsburgh, April 1, 1924

Plates and shapes 2.40c. rather than 2.50c., and the cutting is from 2.40c. rather than from 2.50c. Bars, 2.40c. Black and galvanized sheets are at $2 concession from prices still held rigidly by the Steel Corporation. There is more shading in blue annealed sheets than a week ago, this extending to $3 a ton. Wire products shaded in some districts. Pipe, tin plate and rails firm.

Pig Iron—The stagnation in pig iron continues, there being not enough business to confirm recent asking prices, which were $23 on bessemer, $22 on basic, and $23 on foundry, f.o.b. Valley furnaces.

Connellsville Coke—Largely nominal at $3.75@$4 for spot and $4 for second quarter. Spot foundry remains at $5 @$5.50.

Imports and Exports of Metals, February, 1923 and 1924

Exports of Copper, Lead and Zinc

In Pounds

	February, 1923	February, 1924
Copper		
Ores, concentrates, matte and regulus (copper content)		
Copper and manufactures of	50,689,451	91,543,042
Refined, in ingots and bars	43,810,158	79,821,185
Exported to		
Belgium	1,828,598	5,184,729
France	10,035,918	7,723,975
Germany	10,513,771	12,726,969
Italy	3,878,438	7,165,243
Netherlands	2,587,515	1,132,514
Spain	954,030	481,712
Sweden	2,267,453	2,420,976
United Kingdom	8,965,862	25,291,842
Canada	763,057	1,936,170
China	1,400,000	12,263,200
Japan	.....	2,351,508
Other countries	615,516	1,142,347
Old and scrap	242,809	321,397
Composition metal, copper chief value	3,993	3,051
Pipes and tubes	66,934	161,244
Plates and sheets	447,977	1,322,799
Wire except insulated	698,107	722,317
Lead		
Pigs and bars		
From domestic ore	335,390	996,267
From foreign ore	5,873,351	6,081,455
Exported to:		
France	1,456,722	1,792,511
Germany	1,120,684	338,042
Netherlands	224,135	504,131
United Kingdom	2,072,682	885,264
Other Europe	.....	3,002,792
Argentina	489,593	.....
Brazil	492,922	488,236
Other countries	352,003	66,746
Zinc		
Dross	1,462,949	365,242
Spelter	13,343,595	17,125,292
Exported to:		
Belgium	224,028	112,000
France	112,013	2,318,750
Germany	12,623	391,938
United Kingdom	12,623,810	12,198,941
Canada	2,504	262,602
Other countries	381,240	1,841,061
In sheets, strips, etc.	627,411	772,241
Zinc dust	534,862	328,131
Other zinc manufactures	57,710	30,496

Imports of Ores and Metals

In Pounds Unless Otherwise Stated

	February, 1923	February, 1924
Antimony		
Ore	1,800	363,042
Metal, matte, and regulus	168,085	2,850,874
Copper		
Ore	2,720,753	13,857,422
Concentrates	3,599,927	3,460,460
Regulus, coarse metal, and cement copper	.....	.....
Total	6,320,680	17,317,882
Imported from		
Spain	236,329	2,574,747
Canada	225,826	5,824,253
Mexico	3,558,154	2,084,880
Cuba	.....	1,776,580
Chile	2,146,837	4,795,426
Peru	114,598	14,100
Venezuela	50	.....
Other countries	38,886	247,896
Unrefined black, blister, and converter copper in pigs	23,380,095	37,994,544
Imported from		
Spain	.....	1,413,782
United Kingdom	.....	531,186
Canada	6,163,949	8,837,891
Mexico	7,792,605	5,708,783
Chile	5,313,089	9,552,381
Peru	3,769,655	5,073,385
Portuguese Africa	.....	6,090,290
Other countries	340,797	786,846
Refined copper	8,373,073	13,042,778
Old and clippings for remanufacture	286,857	65,931
Composition metal, copper chief value	116,538	21,820
Copper manufactures	6,666	3,420
Brass		
Old and clippings for remanufacture	5,035,217	1,297,190
Manufactures of brass	29,710	43,231
Lead		
Ore and matte	1,749,851	5,666,070
Bullion or base bullion	9,243,289	9,943,574
Pigs, bars, other forms, and old	2,713,242	3,078,969
Manufactures of, except type metal	12,016	33,801
Manganese ore, long tons	4,636	4,430
Pyrites, long tons	24,843	11,250
Tin		
Tin ore, tons	283	7
Tin in bars, blocks, and pigs	12,429,306	20,599,282
Imported from:		
United Kingdom	2,365,239	3,780,166
British Straits Settlements	8,016,318	14,929,727
China	303,268	.....
Dutch East Indies	58,461	.....
Hongkong	1,187,715	739,487
Australia	372,289	277,760
Other countries	126,016	872,142
Zinc ore (dutiable)	.....	33,506
Zinc in blocks and pigs (dutiable)	2,137	2,796
Zinc dust (dutiable)	667	105

METAL STATISTICS

Monthly Average Prices of Metals

Silver

	New York		London		Sterling Exchange	
	1923	1924	1923	1924	1923	1924
January	65.668	63.447	31.928	33.549	465.053	425.524
February	64.313	64.359	30.875	33.565	468.631	430.457
March	67.556	63.957	32.310	33.483	469.269	428.769
April	66.855	.....	32.346	.....	465.220	.....
May	67.043	.....	32.611	.....	462.252	.....
June	64.861	.....	31.611	.....	461.132	.....
July	63.015	.....	30.942	.....	458.025	.....
August	62.793	.....	30.952	.....	455.714	.....
September	64.203	.....	31.698	.....	453.901	.....
October	63.649	.....	31.718	.....	452.024	.....
November	63.818	.....	32.774	.....	437.839	.....
December	64.705	.....	33.375	.....	435.500	.....
Year	64.873	.....	31.929	.....	457.047	.....

New York quotations, cents per ounce troy, 999 fine, foreign silver. London, pence per ounce, sterling silver, 925 fine.

Copper

	New York		London			
	Electrolytic		Standard		Electrolytic	
	1923	1924	1923	1924	1923	1924
January	14.510	12.401	64.494	61.273	71.409	67.193
February	15.355	12.708	67.700	63.113	74.500	68.167
March	16.832	13.515	73.851	66.137	81.464	72.137
April	16.663	.....	73.169	.....	81.331	.....
May	15.440	.....	67.460	.....	76.568	.....
June	14.663	.....	66.607	.....	73.238	.....
July	14.321	.....	65.278	.....	72.364	.....
August	13.822	.....	64.034	.....	70.000	.....
September	13.323	.....	63.194	.....	68.275	.....
October	12.574	.....	60.614	.....	64.250	.....
November	12.727	.....	61.648	.....	66.477	.....
December	12.823	.....	62.035	.....	67.611	.....
Year	14.421	.....	65.840	.....	72.291	.....

New York quotations, cents per lb. London, pounds sterling per long ton.

Lead

	New York		St. Louis		London	
	1923	1924	1923	1924	1923	1924
January	7.633	7.972	7.571	8.002	27.119	31.528
February	8.050	8.554	8.093	8.643	28.519	34.589
March	8.252	9.013	8.254	8.891	28.815	37.161
April	8.101	.....	7.996	.....	26.956	.....
May	7.306	.....	7.085	.....	25.614	.....
June	7.146	.....	6.852	.....	25.429	.....
July	6.237	.....	6.126	.....	24.188	.....
August	6.582	.....	6.496	.....	24.222	.....
September	6.856	.....	6.700	.....	25.688	.....
October	6.831	.....	6.570	.....	27.815	.....
November	6.846	.....	6.582	.....	30.352	.....
December	7.369	.....	7.369	.....	31.042	.....
	7.267	.....	7.141	.....	27.147	.....

New York and St. Louis quotations, cents per lb. London, pounds sterling per long ton.

Tin

	New York				London	
	99%		Straits			
	1923	1924	1923	1924	1923	1924
January	37.986	48.250	39.173	48.750	181.852	246.790
February	40.693	52.772	42.011	53.272	190.513	272.399
March	46.569	54.370	48.569	54.870	219.607	277.429
April	44.280	.....	45.810	.....	213.081	.....
May	42.346	.....	43.135	.....	203.097	.....
June	40.375	.....	40.957	.....	191.798	.....
July	37.970	.....	38.490	.....	181.188	.....
August	38.841	.....	39.269	.....	186.705	.....
September	41.047	.....	41.547	.....	198.263	.....
October	41.322	.....	41.851	.....	203.957	.....
November	43.495	.....	43.995	.....	220.710	.....
December	46.662	.....	47.160	.....	235.007	.....
Year	41.799	.....	42.664	.....	202.148	.....

New York quotations, cents per lb. London, pounds sterling per long ton.

Zinc

	St. Louis		London	
	1923	1924	1923	1924
January	6.815	6.426	35.733	34.751
February	7.152	6.756	35.613	36.518
March	7.706	6.488	36.720	35.298
April	7.197	.....	34.275	.....
May	6.625	.....	31.057	.....
June	6.031	.....	29.548	.....
July	6.089	.....	29.335	.....
August	6.325	.....	32.386	.....
September	6.438	.....	33.469	.....
October	6.293	.....	32.995	.....
November	6.347	.....	32.949	.....
December	6.260	.....	32.611	.....
Year	6.607	.....	33.058	.....

St. Louis quotations, cents per pound. London, pounds sterling per long ton.

Antimony, Quicksilver and Platinum

	Antimony (a)		Quicksilver (b)		Platinum (c)		
	New York		New York		Refined		Crude
					New York		
	1923	1924	1923	1924	1923	1924	1924
January	6.884	10.279	72.731	59.500	112.462	122.115	115.500
February	7.290	10.935	70.636	59.565	113.273	124.739	115.935
March	8.885	11.442	70.808	64.269	110.846	121.692	113.231
April	8.380	.....	69.200	.....	116.840	.....	.....
May	7.477	.....	68.000	.....	115.007	.....	.....
June	6.839	.....	67.769	.....	115.615	.....	.....
July	7.097	.....	66.980	.....	116.000	.....	.....
August	7.753	.....	65.212	.....	116.000	.....	.....
September	7.633	.....	63.000	.....	116.000	.....	.....
October	8.005	.....	61.769	.....	116.923	.....	.....
November	9.156	.....	61.917	.....	124.479	.....	.....
December	9.365	.....	60.000	.....	125.000	.....	.....
Year	7.897	.....	66.502	.....	116.537	.....	.....

(a) Antimony quotations in cents per lb. for ordinary brands. (b) Quicksilver in dollars per flask. (c) Platinum in dollars per ounce.

Pig Iron, Pittsburgh

	Bessemer		Basic		No. 2 Foundry	
	1923	1924	1923	1924	1923	1924
January	29.27	24.76	27.35	23.76	28.77	23.88
February	29.79	25.26	28.15	23.76	27.21	25.06
March	32.03	25.14	31.79	23.76	31.77	24.76
April	32.77	.....	32.77	.....	32.77	.....
May	31.87	.....	29.83	.....	32.46	.....
June	30.27	.....	28.34	.....	29.81	.....
July	28.47	.....	26.52	.....	27.47	.....
August	28.27	.....	26.77	.....	26.77	.....
September	28.26	.....	26.26	.....	26.72	.....
October	26.96	.....	25.01	.....	25.52	.....
November	24.79	.....	22.57	.....	23.60	.....
December	24.54	.....	22.62	.....	23.72	.....
Year	28.94	.....	27.33	.....	28.05	.....

In dollars per long ton.

Monthly Crude Copper Production

Domestic

	1923		1924	
	November	December	January	February
Alaska shipments	8,651,360	6,706,322	5,753,719	8,248,221
Calumet & Arizona	3,688,000	3,876,000	3,764,000	2,824,000
Miami	5,883,000	5,667,345	5,884,000	4,965,000
New Cornelia	3,059,377	3,221,044	3,221,044	4,452,402
Old Dominion	2,315,000	2,156,000	2,344,000	2,250,000
Phelps Dodge	12,592,000	11,114,000	9,818,000	10,112,000
United Verde Extension	3,242,970	4,189,856	3,517,862	3,901,444
Others, estimated (b)	17,000,000	13,750,000	12,500,000	16,200,000
Imports: Ore and concentrates, matte	12,682,229	13,883,925	10,168,066	17,317,820
Partly from				
Chile	1,287,744	4,486,649	6,755,405	4,795,426
Cuba	5,074,688	3,332,723	.....	1,776,580
Canada	1,994,624	32,433	94,167	5,824,253
Mexico	1,658,862	1,721,619	1,271,400	2,084,880
Imports of black and blister, unrefined	44,438,675	18,802,829	41,962,680	37,994,544
Partly from				
Chile	9,855,661	569,913	1,664,624	9,552,381
Peru	12,011,652	405,705	7,538,508	5,073,385
Africa	12,017,927	6,364,020	20,525,910	6,090,290
Mexico	6,781,241	4,430,127	7,229,476	5,008,783
Imports of refined and old	3,207,054	20,547,641	16,941,465	13,133,379

Foreign

Boleo, Mexico	1,454,198	1,378,125	1,486,721	1,356,075
Falcon Mines, Rhodesia	(a)	508,000	492,000	494,800
Furukawa, Japan	2,649,288	2,794,476	2,162,972	(a)
Granby Cons., Canada	2,692,616	2,889,014	3,268,463	2,934,214
Katanga, Africa	10,460,520	10,969,875	11,299,900	11,243,295
Mount Morgan, Aust.	(a)	1,158,000	493,000	(a)
Mount Lyell, Aust.	1,524,000	882,000	774,000	(a)
Phelps Dodge Mexican	2,373,000	4,048,000	3,395,000	2,983,000
Sumitomo, Japan	2,956,912	2,829,043	2,713,584	(a)
Wallaroo & Moonta, Aust.	584,599	(a)	(a)	(a)

Comparative U. S. Monthly Copper Production

	1921	1922	1923	1924
January	90,596,597	32,010,292	112,267,000	133,356,000
February	86,682,941	45,957,530	102,725,000	128,260,000
March	91,046,345	55,705,760	121,562,000	.....
April	46,946,523	76,601,000	118,157,000	.....
May	25,310,511	88,714,000	125,438,000	.....
June	24,623,693	93,740,000	125,479,000	.....
July	22,033,739	91,000,000	125,249,000	.....
August	23,248,398	101,188,000	131,088,000	.....
September	23,855,316	96,408,000	124,523,000	.....
October	23,231,572	103,273,000	132,481,000	.....
November	28,341,442	102,845,000	127,963,000	.....
December	26,629,137	103,003,000	129,354,000	.....

(a) Not available. (b) Chiefly A. S. & R. Co.

MINING STOCKS

Week Ended March 29, 1924

Stock	Exch.	High	Low	Last		Last Div.
COPPER						
Alaska-Br. Col.	N. Y. Curb	*30	*25	*25		
Anaconda	New York	32⅞	31½	31½	De.15, Ja.21, Q	0.75
Arcadian Consol.	Boston	1½	1½	1½		
Ariz. Com'l.	Boston	8⅛	8⅛	8⅛	Ja.15, Ja.31	0.50
Calaveras	N. Y. Curb	1⅜	1⅜	1⅜		
Calumet & Arizona	Boston	43½	41½	42	Mc.7, Mc.24, Q	0.50
Cal. & Hecla (New)	Boston	15⅞	15½	15½	De. 1, De. 17	0.50
Canario Copper	N. Y. Curb	2¼	2 1/16	2¼		
Cerro de Pasco	New York	45½	40⅜	41	Ja. 17, Feb. 1	1.00
Chile Copper	New York	26⅞	25⅛	25⅜	Mc.1 Mc.29, Q	0.62½
Chino	New York	15⅝	15	15	Sept. '20, Q	0.37½
Con. Coppermines	N. Y. Curb	2⅜	2 1/16	2⅜		
Copper Range	Boston	23	21½	21½	May '23, Q	1.00
Crystal Copper	Boston Curb	72	72	72		
Davis-Daly	Boston	4⅜	4 1/16	4⅜	Mar. '20, Q	0.25
East Butte	Boston	4⅞	4⅜	4½	Dec. '19, A	0.50
First National	Boston Curb	29	26	26	Feb. '19, SA	0.15
Franklin	Boston	*85	*80	*80		
Gadsden Copper	Boston Curb	*45	*35	*45		
Granby Consol.	New York	14⅛	13⅛	13⅛	May '19, Q	1.25
Greene-Cananea	New York	14⅜	14	14	Nov. '20, Q	0.50
Hancock	Boston	1	1	1		
Howe Sound	N. Y. Curb	2⅜	2⅜	2⅜	Ap.1, Ap.15, Q	0.05
Inspiration Consol.	New York	24	23	23	De.20, Ja.7, Q	0.50
Iron Cap	Boston Curb	2½	2½	2½	May 23, K	0.15
Isle Royale	Boston	15	13½	13½	Se. 1, Se. 15,	0.50
Jerome Verde Dev.	N. Y. Curb	1⅛	1⅛	1⅛		
Jib Consol.	N. Y. Curb	*27	*20	*20		
Kennecott	New York	35½	34½	34⅝	Mc.7, Ap. 1, Q	0.75
Keweenaw	Boston	*55	*50	*50		
Lake Copper	Boston	1½	1	1		
Magma Copper	New York	33⅛	32½	32⅝	Jan. '19, Q	0.50
Mason Valley	N. Y. Curb	1⅜	1⅛	1⅛		
Mass Consolidated	Boston	*75	*75	*75	Nov. '17, Q	1.00
Miami Copper	New York	21⅛	20½	20⅝	Fe. 1, Fe. 13, Q	0.50
Michigan	Boston			*50		
Mohawk	Boston	*31⅛	*27	*27⅛	Se. 22, Oc. 13,	1.00
Mother Lode Con.	New York	8⅛	7⅞	7⅞	De.14, De.31	0.50
Nevada Consol.	New York	12⅞	12½	12⅝	Sept. '20, Q	0.25
New Cornelia	Boston	*17⅞	*16½	*16⅜	Au.3, Au.20, Q	0.25
New Dominion	N. Y. Curb	2⅜	2⅜	2⅜		
North Butte	Boston	2⅜	2⅜	2⅜	Oct. '18, Q	0.25
Ohio Copper	N. Y. Curb	*70	*65	*67		
Old Dominion	Boston	18	16½	17⅛	Dec. '18, Q	1.00
Osceola	Boston			31½	June '23, Q	1.00
Phelps Dodge	Open Mar.	†135	†120		Mc.24, Ap.2 Q	1.00
Quincy	Boston	19	18⅜	18⅜	Mar. '20, Q	1.00
Ray Consolidated	New York	9⅛	9	9⅛	Dec. '20, Q	0.25
Ray Hercules	N. Y. Curb	*15	*15	*15		
St. Mary's Min. Ld.	Boston	*30½	*28	*28	No.9, De.11, K	1.00
Seneca Copper	New York	3⅞	3⅛	3⅞		
Shannon	Boston	*40	*31	*31	Nov. '17, Q	0.25
Shattuck Arizona	New York	5⅜	5⅛	5⅛	Jan. '20, Q	0.25
South Lake	Boston			*25		
Superior & Boston	Boston	*80	*50	*50		
Tenn. C. & C. cfs.	New York	7	7	7	De.31, Ja.15, Q	0.25
Tuolumne	Boston			*42	May '13,	0.10
Utah Copper	New York	67	65	65⅛	Mc.14, Mc.31, Q	1.00
Utah Metal & T.	Boston	*35	*35	*35	Dec. '17,	0.30
Victoria	Boston			*65		
Walker Mining	N. Y. Curb	3⅛	3	3		
Winona	Boston	*25	*20	*20		
Wolverine	Boston			5⅜		
NICKEL-COPPER						
Internat. Nickel	New York	13⅜	12⅞	12⅞	Mar. '19,	0.50
Internat. Nickel pfd.	New York	80	78⅛	78⅛	Ja.17, Fe.1, Q	1.50
LEAD						
Carnegie Lead & Zinc	Pittsburgh	2⅛	2⅛	2⅛		
National Lead	New York	141	133	133⅛	Mc.14, Mc.31, Q	2.00
National Lead pfd.	New York			114½	No. 23, De. 15	1.75
St. Joseph Lead	New York	25	23¾	23¾	Mc. 20, 24	0.50
ZINC						
Am. Z. L. & S.	New York	7	7	7	May '20	1.00
Am. Z. L. & S. pfd.	New York	25¼	24⅛	25	Nov. '20, Q	1.50
Butte C. & Z.	New York	5	4⅞	4⅞	Ma. '23,	0.50
Butte & Superior	New York	16⅛	15⅜	15⅜	Je.15, Je. 30, Q	0.50
Callahan Zn-Ld.	New York	4⅛	4⅛	4⅛	Dec. '20, Q	0.50
New Jersey Zn.	N. Y. Curb	148	148	148	Ap.30, My.10, Q	2.00
United Zinc	N. Y. Curb			*25		
Yellow Pine	Los Angeles			*75	Dec. '23	0.03
SILVER						
Alvarado	N. Y. Curb			1⅛		
Batopilas Mining	New York	⅛	⅛	⅛	Dec. '07, I	0.12
Beaver Consol.	Toronto	†*29⅛	†*26	*23½	May '20, K	0.03
Castle-Trethewey	Toronto	†*37	†*36	*39		
Coniagas	Toronto	2.20	2.10	2.10	Oc.19, No.1, '23	0.02½
Crown Reserve	Toronto	†*64	†*63	*62	Jan. 17,	0.05
Keeley	Toronto	2.34	2.28	2.32		
Kerr Lake	N. Y. Curb	1⅞	1⅞	1⅞	Ap.1, Ap. 15, Q	0.12
La Rose	Toronto	*19½	*13½	*14½	Apr. '22,	0.10½
McKinley-Dar.-Sav.	Toronto	*16	*15	*15	Oct. '20, Q	0.03
Mining Corp. Can.	Toronto	3.45	3.40	3.45	Sept. '20, Q	0.12
Nipissing	N. Y. Curb	6⅞	6	6	Mc.1, Ap.21, Q	0.03½
Ontario Silver	New York	5	4⅜	4⅜	Jan. '19, Q	0.50
Temiskaming	Toronto	*30	*27½	*30	Jan. '20, K	0.40
Tretheway	Toronto	†*14¼	†*14	13½		

Stock	Exch.	High	Low	Last		Last Div.
GOLD						
Alaska Gold	New York	¼	¼	¼		
Alaska Juneau	New York	1⅜	1⅛	1⅛		
Argonaut	Toronto	*54	*51	*51		
Carson Hill	Boston	1⅛	1⅛	1⅛		
Cresson Consol. G.	N. Y. Curb	4 1/16	4	4	Mc.3, Ap.10, Q	0.10
Dome Mines	New York	18⅜	17½	17½	Mc.26, Ap.21, Q	0.5
Golden Cycle	Colo. Springs	1.36½	1.30	1.30	De. '22, Q	0.0
Hollinger Consol.	Toronto	12.40	12.25	12.35	Mc.6, Mc.24, M	0.0
Homestake Mining	New York	49¼	49	49½	Mc.20, Mc.25, M	0.5
Kirkland Lake	Toronto	*24	*20⅛	*21½		
Lake Shore	Toronto	3.85	3.80	3.85	Fe.2, Fe.24, Q	0.02
McIntyre-Porcupine	New York	16	15½	13⅜	Ap. 1, My. 1,	0.25
Newray	Toronto	†*36½	†*35½	*35		
Portland	Colo. Springs	*52	*52	*52	Oct. '20, Q	0.01
Teck-Hughes	N. Y. Curb	1½	1½	1½		
Tom Reed	Los Angeles			*38½	Dec. '19,	0.02
Tough-Oakes	Toronto	*70	*67½	*68		
United Eastern	N. Y. Curb	*90	*85	*90	Ja.8, Ja.28, Q	0.15
Vipond Cons.	Toronto	1.23	1.16	1.17		
Wright-Hargreaves	Toronto	3.00	2.85	3.00	Mc.15, Ap. 1, Q	0.02½
Yukon Gold	N. Y. Curb	*65	*60	*65	June '18,	0.02
GOLD AND SILVER						
Con. Cortez	N. Y. Curb	*47	*44	*46		
Con. Virginia	San Francisco	*3½	*3½	*3½		
Continental Mines	N. Y. Curb	2½	2½	2½		
Dolores Esperanza	N. Y. Curb	*55	*50	*51	Jy. 1, Jy. 10 Q	0.05
Premier Gold	N. Y. Curb	2⅛	2	2	Mc.28, Ap.5	0.08
Tonopah Belmont	N. Y. Curb	*56	*56	*56	Apr. '23, Q	0.05
Tonopah Divide	N. Y. Curb	*31	*29	*31	Se.22, Oc. 10	0.10
Tonopah Extension	N. Y. Curb	1 1⅛	1 1⅛	1 1⅛	Mc. 11, Ap. 1	0.05
Tonopah Mining	N. Y. Curb	1 1/16	1 1/16	1 1/16	Ap. 6, Ap. 21	0.07½
Unity Gold	N. Y. Curb	2	1⅛	1⅛		
West End Consol.	N. Y. Curb			*66	Mar. '23, Q	0.05
SILVER-LEAD						
Ahumada	Boston Curb	5⅛	5⅛	5⅛	Mc., Ap. 2, X	0.15
Bingham Mines	Boston	15⅛	15⅛	15⅛	Sept 19, Q	0.25
Cardiff M. & M.	Salt Lake	95	95	95	Dec. '20,	0.15
Chief Consol.	Boston Curb	3⅛	3	3	Ja 11, Fe.1, Q	0.10
Columbus Rexall	Salt Lake	*26	*25	*25	Aug. '22	0.03
Consol. M. & S.	Montreal	38	36¼	36½	Oct. '20, Q	0.62½
Daly Mining	Salt Lake			2.15	July '20	0.10
Erupcion	Boston Curb	2⅛	2	2⅛	Mc. 15, Ap.2, X	0.15
Federal M. & S.	New York			11	Jan., '09	1.50
Federal M. & S. pfd.	New York	43⅛	42½	42½	Fe.26, Mh.15, Q.	1.75
Florence Silver	Spokane	*20	*19½	*19½	Apr. '19, QX	0.01
Hecla Mining	N. Y. Curb	9⅛	8⅛	8⅛	Fe.15, Mh.15Q	0.25
Indian Mines	N. Y. Curb			*64		
Iron Blossom Con.	N. Y. Curb	*30	*30	*30	Oct. 26, '23,	0.02
Marsh Mines	N. Y. Curb	*9	*9	*9	June '21, I	0.02½
Park City	Salt Lake			4.75	Mc.15, Ap.1	0.15
Park Utah	N. Y. Curb			3½	Mc.15, Ap.1	0.15
Prince Consol.	Salt Lake			*75	Nov. '17,	0.02
Silversmith	Spokane	†41.5	†39.75	41.65	Mc. 27, Ap. 10	0.01
Tamarack-Custer	Spokane	1.80	1.77	1.77	Se.30, Oc. 1, K	0.02
Tintic Standard	Salt Lake	4.50	4.30	4.35	Mar. 25, 24, QX	0.15
Utah-Apex	Boston	2⅛	2⅛	2⅛	June '23, QX	0.50
IRON						
Bethlehem Steel	New York	53⅛	49⅞	49⅞	Mh. 1, Ap. 1, Q	1.25
Char. Iron	Detroit	¼	¼	¼		
Char. Iron pfd.	Detroit			1½		
Colorado Fuel & Iron	New York	32½	29½	29½	Fe.11, Fe.25 Q	2.00
Col. Fuel & Iron pfd.	New York			102	Fe.11, Fe.25, Q	2.00
Gt. North'n Iron Ore	New York	30⅜	29⅜	30	De.10, De.27	2.00
Inland Steel	N. Y. Curb			46	Mh.15, Apl. 1 Q	0.62½
Mesabi Iron	N. Y. Curb	6	6	6		
Replogle Steel	New York	10	9	10		
Republic I. & S.	New York	49¾	45½	45½	May '21	1.50
Republic I. & S. pfd.	New York	88	87½	87½	Mh.20, Ap.1 QX	2.75
Sloss-Sheffield S.&I.	New York	59½	56½	56½	Mc.10, Mc.20	1.50
Sloss-Shef. S.&I.pfd.	New York			84	De.20, Ja.2, Q	1.75
U. S. Steel	New York	100⅛	97	97¼	Mc. 29, QX	1.75
U. S. Steel pfd.	New York	119⅛	119	119⅛	Mc. 29, Q	1.75
Virginia I. C. & C.	New York	48	48	48	De.15, Ja. 2	1.50
Virginia I.C.&C.pfd.	New York			78	De.15, Ja.22	2.50
VANADIUM						
Vanadium Corp.	New York	26¼	24⅝	25⅛	Jan. '21, Q	1.00
ASBESTOS						
Asbestos Corp.	Montreal			35	Se.29, Oc.15 Q	1.00
Asbestos Corp. pfd.	Montreal			60	Ap.1, Ap.15, Q	1.50
SULPHUR						
Freeport Texas	New York	9⅞	9⅜	9⅜	Nov. '19, Q	1.00
Texas Gulf	New York	60	58½	58½	Mh.3, Mh.15QX	1.75
PLATINUM						
So. Am. Gold & P.	N. Y. Curb			3⅞		
MINING, SMELTING AND REFINING						
Amer. Metal	New York	43⅞	43	43	Fe.18, Mh.1, Q	0.75
Amer. Metal pfd.	New York	109	109	109	Fe.20, Mh.1, Q	1.75
Amer. Sm. & Ref.	New York	60⅛	57⅛	58⅛	Ja. 11, Fe. 1, Q	1.25
Amer. Sm. & Ref. pfd.	New York	98⅛	97½	98⅛	Fe.20, Mh.1,	1.75
U. S. Sm. R. & M.	New York	20⅛	18⅛	19¼	Jan. '21, Q	0.50
U. S. Sm. R. & M. pfd.	New York	38⅛	38⅛	38⅛	Ja.7, Ja.15 Q	0.87½

* Cents per share. † Bid or asked. Q, Quarterly. SA, Semi-annually. M Monthly. K, Irregular. I, Initial, X, Includes extra.

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